Railway Age Gazette

DAILY EDITION

Copyright, 1914, by the Simmons-Boardman Publishing Co.

Vol. 56. CHICAGO—MARCH 18, 1914—NEW YORK No. 11b.

PUBLISHED DAILY BY

Simmons-Boardman Publishing Co., Transportation Bldg., Chicago, Ill., on the occasion of the annual convention of the American Railway Engineering Association and the stated meeting of the Railway Signal Association.

NEW YORK: Woolworth Bldg. CLEVELAND: Citizens Bldg.
LONDON: Queen Anne's Chambers, Westminster.

EDWARD A. SIMMONS, *President.*
L. B. SHERMAN, *Vice-President.* HENRY LEE, *Sec'y & Treas.*
The address of the company is the address of the officers.

EDITORS:

SAMUEL O. DUNN, *Editor.*
ROY V. WRIGHT, *Managing Editor.*
B. B. ADAMS
E. T. HOWSON
W. E. HOOPER
H. F. LANE
H. H. SIMMONS
R. H. WHITE
R. E. THAYER
A. C. LOUDON
F. W. KRAEGER
C. W. FOSS
G. L. FOWLER

Subscriptions, including 52 regular weekly issues and special daily editions published from time to time in New York, or in places other than New York, payable in advance and postage free:

United States and Mexico.....$5.00
Canada 6.00
Foreign Countries (excepting daily editions)..... 8.00
Single Copies.....15 cents each

Engineering and Maintenance of Way Edition and the four Maintenance of Way Convention Daily issues, North America, $1.00; foreign (excepting daily editions), $2.00.

Application made at the Post Office at Chicago, Ill., for entry as mail matter of the second class.

WE GUARANTEE, that of this issue 10,900 copies were printed; that of those 10,900 copies, 9,759 copies were mailed or delivered by messenger to regular paid subscribers; 845 copies were distributed among members and guests of the American Railway Engineering Association and at the Coliseum; 146 copies were mailed to advertisers; and 150 copies were set aside for office use.

Contents

EDITORIAL:

Editorial Notes..... 589
The Engineering Association in Valuation Work..... 590

PROCEEDINGS:

American Railway Engineering Association..... 592

MISCELLANEOUS:

Announcements 590
President Willard on the Rate Advance Case..... 591
Registration of the American Railway Engineering Association 612
Reception and Dinner for Ira O. Baker..... 616

Cost of Hump Yard Switching

The variation in the cost per car for switching in hump yards of from $0.075 reported by two roads to a maximum given in the report of the committee on Yards and Terminals of $0.50 is greater than one would expect to find. However, this wide variation is undoubtedly due to two causes: the difference in methods of computing cost and varying local conditions. It is very difficult to secure data prepared upon the same basis from different yards on the same system. It is far more difficult to secure comparable data from different roads. Also, the nature of the traffic, the degree of congestion, the yard layout, the type of motive power and other conditions greatly influence the cost of operation of the yard. The most interesting information in this table is that showing the average cost of operation of hump yards as reported by 28 roads to be $0.212 per car, while 11 roads reported a cost of $0.2291 per car for flat yards. The saving of hump yards, therefore, is in increased capacity rather than in initial economy. It is also interesting to note that of the 95 hump yards reported by this committee, 31, or practically one-third of the total, are on the Pennsylvania.

Large Parties Visiting Convention

One indication of the increasing recognition of the educational value of the Association is reflected in the growing practice on numerous roads of sending their maintenance officers to visit the convention. Several roads also require the men attending the convention to prepare reports for the benefit of those men remaining on the road. In yesterday morning's edition we noted the fact that four assistant superintendents of the Southern Pacific Lines in Louisiana and Texas were in attendance at the convention. Over 40 officers of the Baltimore & Ohio are here, including President Willard and Vice-President Thompson. About fifty Grand Trunk engineers are also here, including Vice-President Kelly.

The Science of Organization

It is an interesting sign of the times that one of the subjects assigned this year to the committee on Rules and Organizations was that of the Science of Organization. The committee stated that a report has been made to the Board of Direction, which President Wendt stated yesterday would be published in an early bulletin. While the subject of scientific management has not been given serious consideration by many railway men, others have realized that there is great room for improvement in many ways, and among others in the details of organization. The report of this committee will undoubtedly be in harmony with this latter view; and it will be interesting to see just how the members propose to deal with this subject.

Co-operation on Combined Maintenance

A pertinent suggestion was made on the floor of the convention yesterday morning after the report of the sub-committee on the Economics of Labor in Signal Maintenance by a member of the sub-committee of the Committee on Track, which is studying the Economics of Track Labor. This member believes that co-operation between these two sub-committees in discussing the possibility of combining the duties of track men and signal maintainers would do much to harmonize the diametrically opposed views now held on this subject. The fact that the sub-committee of the signals and interlocking committee, which considered this subject, was unable to present enough definite information to stimulate discussion would seem to indicate that a little infusion of the views of the opposite side into the discussions might improve the quality of the report.

Organization for Yard Operation

The suggestion made by Mr. Stuart yesterday morning, in discussing the report of the committee on Yards and Terminals, that the committee should not end its work with the design of yards, but should also work out plans for the organization and operation of these yards, is very pertinent. A study of the method of operation is essential to the successful design of any yard, and if, after completion, it is not operated in accordance with the principles laid down in the design, it may prove a failure, even though designed according to approved methods. Well laid out yards have been considered failures in actual operation because no plans for their operation were developed. The studies

of design and of operation are so closely related that the experience gained by the committee in studying the design of yards should also be utilized in outlining methods for their operation.

Discussion of Reports

The discussion of the various reports on Tuesday was disappointing. With an unusually large attendance for the opening day, the discussion was very limited, and was largely brought out by the action of President Wendt in calling on different persons. The subjects presented included a number of interesting and highly important subjects, including the Science of Organization, the Mechanical Handling of Freight, the Design and Operation of Large Terminals, etc. These subjects are now of vital interest to the members of this association, and a large number of members have information on them. They owe it to the Association and to the different committees to give the Association at large the benefit of this information. The discussions of the various reports should be of as much value and should bring out as much information as the reports themselves.

THE ENGINEERING ASSOCIATION IN VALUATION WORK

One of the largest, most complicated and most important of the problems now engaging the attention of railway engineers is that created by the enactment last year by Congress of the law empowering the Interstate Commerce Commission to make a valuation of the railways of the country. Although the act became effective on May 1 last, most of the work that has been accomplished thus far has been in the direction of organization. In this connection it is interesting to note what a prominent relation to this great undertaking has been given to the American Railway Engineering Association, by reason of the identification of so many of its members with the work both in the commission's organization and in the valuation committees that have been formed by a large number of roads to handle the problems that will arise.

It should be a source of considerable gratification to the association that its standing has been given such prominent recognition as is indicated by the selection of two of its officers, President Wendt and Professor Pence, who has been for several years editor of its publications, as two of the five members of the engineering board, which has general charge of the work under Director Prouty. Moreover, Mr. Wendt was given charge of the first district, which is generally recognized as presenting the most complicated of the problems to be encountered.

In the organization subordinate to the board also the association is well represented. Of the five district engineers appointed by the board, Frank Rhea, of the first district, is a member of the association, and all five of the assistant district engineers, who were selected after a competitive civil service examination, C. H. Spencer, W. G. Atwood, George H. Bremner, B. J. Dalton and M. P. Paret, are also members, Mr. Bremner having been an officer for several years, and Mr. Spencer and Mr. Atwood committee chairmen. M. A. Zook, office engineer for the board, is also a member.

While the valuation work imposes a gigantic task upon the Interstate Commerce Commission, the expense of which will run into many millions of dollars, the railways themselves are also called upon to shoulder an immense burden of detailed work and expense in assisting the commission in its undertaking and in looking after their own interests in connection with it. Therefore the roads themselves have formed their committees of presidents and of engineers to represent the interests of the railways as a whole, and the larger roads individually have formed valuation committees, in many cases taking some of the chief engineering officers away from their work to devote their entire time to valuation problems. In this work, too, the association members are taking an active part, and the following have been assigned by their respective companies to handle valuation questions: A. W. Carpenter, New York Central & Hudson River; L. S. Rose, Cleveland, Cincinnati, Chicago & St. Louis; A. L. Sarvey, Michigan Central; A. J. Himes, New York, Chicago & St. Louis; Charles S. Churchill, Norfolk & Western; J. B. Berry, Chicago, Rock Island & Pacific; George H. Burgess, Delaware & Hudson; H. L. Ripley, New York, New Haven & Hartford; S. B. Fisher, Missouri, Kansas & Texas; W. C. Cushing and W. D. Wiggins, Pennsylvania Lines West; D. W. Lum, Southern Railway; William McNab, Grand Trunk; J. B. Jenkins, Baltimore & Ohio; J. H. Roach, Lake Shore & Michigan Southern, and A. W. Newton, Chicago, Burlington & Quincy. Of these Messrs. Churchill, Cushing and McNab are past presidents of the association.

In view of the above President Wendt's recommendations in his opening address, concerning the part the association should take in studying the complicated questions involved and the interest it should take in the work, are especially appropriate, and the suggestion regarding the appointment of a special committee on valuation merits careful consideration.

TO-DAYS PROGRAMME

VIII.	Masonry	Bulletin 163
V.	Track	Bulletin 163
XVIII.	Electricity	Bulletin 163
XVII.	Wood Preservation	Bulletin 163
Special.	Grading of Lumber	Bulletin 163
XIII.	Water Service	Bulletin 163
VI.	Buildings	Bulletin 163
IV.	Rail	Bulletin 164

Annual Dinner at 7:00 p. m.

ANNUAL MEETING NATIONAL RAILWAY APPLIANCES ASSOCIATION

The annual meeting of the National Railway Appliances Association was held Tuesday morning at the Coliseum. President Wyles, in his annual report, called attention to the successful publication of the Year Book, in its second year, but stated that in view of the fact that it had been published two years, and in view of the unusual amount of detail devolving on a very few members for the consummation of such a task, he did not believe the publication should be issued next year. Perhaps, he added, it would be possible and profitable, from an invitation standpoint, to again produce the volume, but it should be an association proposition rather than be dependent on the efforts of individuals. The work of advertising the exhibition, however, through the technical press and other proper channels, should be vigorously pushed and made stronger each year.

Treasurer Reynolds reported a 1913 surplus of $8,930.39, with no liabilities. The 1914 figures, when complete, will probably indicate a small deficit. Mr. Reynolds, after serving the Association as its treasurer during the past 12 years, tendered his resignation, which was accepted by the Association. In behalf of the Association and its officers, Director J. Alexander Brown presented Mr. Reynolds with a handsome loving cup. The presentation was warmly applauded by the members.

A vote of thanks was presented to the Publication Committee and its chairman, Mr. Sperry, and to the retiring officers. After deciding to keep the Coliseum exhibition open until

10 o'clock during the week, the Association elected the following officers for the ensuing year:

President, Norman M. Hench, Carnegie Steel Co.; vice-president, P. W. Moore, The P. & M. Co.; treasurer, C. W. Kelly, Kelly-Derby Co.

Directors: One year—George Parker, Cleveland Frog & Crossing Co. Three years—E. E. Hudson, Thomas A. Edison, Inc.; M. J. Trees, Chicago Bridge & Iron Works.

PRESIDENT WILLARD ON THE RATE ADVANCE CASE

President Daniel Willard, of the Baltimore & Ohio, who is at the Congress hotel, yesterday gave the Daily Railway Age Gazette an interview regarding the eastern rate advance case in which he urged especially the need for an early decision by the Commission. Mr. Willard is chairman of the committee of presidents of eastern railroads that is handling the case of the eastern lines for a 5 per cent increase in their freight rates.

"The railways have no criticism to make regarding the course which the Commission has thus far adopted," Mr. Willard said, referring in particular to the Commission's course in considering together the questions of advances of rates and of extra charges for the switching of cars, etc. "The situation is simply this: We contend that we need an increase of net earnings, and we have suggested a general advance in freight rates as the best means of securing it. We have, therefore, filed tariffs that would increase our freight rates an average of 4 or 5 per cent. The Commission and its attorney, Mr. Louis D. Brandeis, evidently have thought that it might be feasible and desirable for us to get the additional revenue by ceasing to pay certain allowances for switching cars and other services for which we now pay shippers, and to begin to charge for certain services which we now render to them free. As the Commission thought thus it was its right, and perhaps its duty, to investigate the merits of this plan. But from the time that this plan of the Commission's was suggested it has been met by the shipping public with vigorous and even bitter opposition. The shippers contend that the practices which the Commission considers causing to be abolished have been in existence for many years; that entirely to change them would be very harmful to many concerns; and that, therefore, no complete change in them should be made without a comprehensive and thorough investigation.

"The railways have taken no active part either for or against the extensive changes in practices which have been suggested. If the Commission shall become convinced that their adoption will be the best means of increasing the carriers' revenue the carriers will, undoubtedly accept its view. From what has developed already, however, it would appear, not only that the extensive changes in transportation practices which Mr. Brandeis appears to favor would meet with the most widespread and determined opposition from the shipping public, but also that there is merit in the shippers' contention that such action should be taken only after a thorough investigation. But the eastern railways should not be required to wait for an increase in their revenues until such an investigation can be made and concluded. They believe that they have introduced testimony which should convince, and has convinced, the Commission that their financial necessities are real, immediate and pressing. This 'being the case,' any action that may be taken to relieve those necessities should in the interest of all be taken at the earliest practicable date, and the longer it is deferred the more serious the consequences to the railways in particular, and to the business of the country in general, must be.

"It would seem, therefore, that the wise and fair course for the Commission to take—the one which would be best for the business interests of the country as well as the railways—would be to grant the increases in rates which are provided for in the tariffs which the eastern roads already have on file. After this had been done the Commission could go on with its investigation of transportation practices, and give the shipping interests the full hearing which they demand. If the Commission's final decision regarding these practices should result in further increases in the carriers' net revenues and the Commission should feel that these increases, together with those due to the advances in rates, were too great, it could of course make such reduction in rates as it might consider justifiable."

"THE ASSOCIATION'S VOLUMINOUS PROCEEDINGS"

The Association has published during the past year, more than 4,000 printed pages—4,198 to be exact. This includes 10 issues of the bulletin, one volume of the proceedings, a supplement to the Manual, and the program and miscellaneous leaflets. The complete publications of this Association now fill 34,564 pages. The bulletin was admitted to the privileges of second-class mail rate shortly after last year's convention, thus effecting an important saving in the cost of postage. One result of the rapid growth of the size of the publication is the difficulty that is experienced in finding desired matter that has been published. To eliminate this difficulty the Association has arranged for the preparation of a complete index to cover the 15 volumes of annual proceedings.

HARLAN ELECTED CHAIRMAN INTERSTATE COMMERCE COMMISSION

James S. Harlan was yesterday elected chairman of the Interstate Commission, succeeding Edgar E. Clark, in accordance with the policy adopted by the commission a few years ago of electing each year as its chairman the senior member of the commission. Mr. Harlan is a Chicago man and was appointed to the commission in 1906. He was reappointed in 1911, and his present term will expire December 31, 1918.

A CASE OF MISTAKEN IDENTITY

The gentleman wearing the little blue button with the number 920 is not the G. M. & C. E., of the Guantanamo Railway, nor does he live in Guam, Cuba, as is stated in the list of members of the A. R. E. A., following the name of N. E. Brooks. Mr. Brooks is not from the far south, as indicated, but from the far north. He is engineer of maintenance of way of the western lines, Canadian Pacific, with headquarters at Winnipeg.

FUNDS AVAILABLE FOR INVESTIGATION OF STRESSES IN TRACK

Before leaving New York Chairman Dawley of the Roadway Committee received the personal assurance of President Farrell of the Steel Corporation that the $10,000 recently tendered by the Steel Corporation for the study of the stresses in track, to be conducted by the American Railway Engineering Association jointly with the American Society of Civil Engineers, is now available, and that a check for this amount would be mailed to the secretary of the Association on Tuesday.

EXHIBITS OPEN EVENINGS

The exhibit at the Coliseum will remain open every night until 10 p. m., except Friday night, when it will close at 6 p. m.

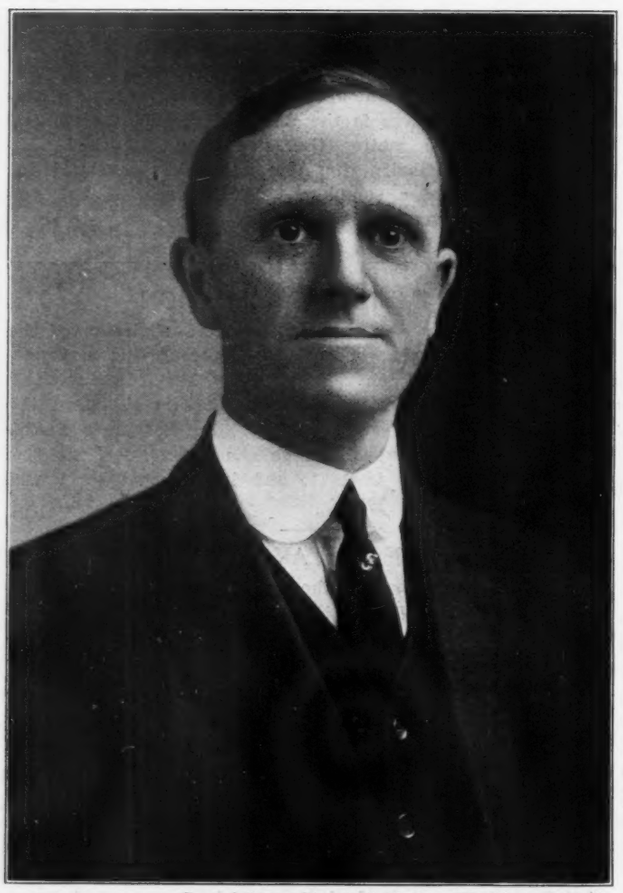
Proceedings of Railway Engineering Association

Abstracts of Six Reports Including Rules and Organization, Signals, Yards, Roadway and Wooden Bridges

The Fifteenth Annual Convention of the American Railway Engineering Association opened at 9:30 a. m. on Tuesday, March 17, in the Florentine Room, Congress Hotel. The regular afternoon session began at 2:15 p. m. Edwin F. Wendt, member of the Engineering Board of the Interstate Commerce Commission, president of the Association, was in the chair. After approving the minutes of the last convention and listening to the president's address and the report of the secretary and treasurer, the reports of the following regular committees were taken up: Rules and Organization; Signals and Interlocking; Yards and Terminals; Roadway; Wooden Bridges and Trestles, and Iron and Steel Structures. The abstracts of these reports with discussions follow:

PRESIDENT'S ADDRESS

Fifteen years have passed since the organization of our Association. The men who gathered at the first convention, held in Steinway Hall, Chicago, on March 14, 1900,



Copyright by Harris & Ewing, Washington, D. C.

EDWIN F. WENDT, President.

probably had a vision of the future; but the success of our efforts has exceeded even the fondest hopes of those who organized the Association. They certainly heard a Voice, saying, "It doth not yet appear what we shall be." And we hear the same voice to-day, but the question now is, not one of success, but how strong and useful may the Association become.

The fiscal year of our Association is the same as the calendar year. During 1913 the revenues were $25,888, and the expenditures, $22,263. Therefore, the surplus for the year was $3,625. These figures show that the Association is fairly prosperous; but in order to draw safe deduction, consideration should be given to the relation of revenues to expenses for a period of five years. It will be necessary to reprint the manual in the near future, at an expense of about $3,500, and the conservative policy of the Board of Direction with reference to the authorization of money for experimental purposes will no doubt prevail until such time as there is a larger revenue.

The progress of the work of the Association is reflected in the increase of the text of the proceedings from 200 pages in 1900 to about 2,000 pages in 1914.

Past President John F. Wallace, in his address at Steinway Hall, Chicago, March 14, 1900, stated that "The establishment of certain recognized principles as the result of our investigations and discussions, will materially assist our managements in adopting a policy that will lead to the truest and highest economy." The manual is an expression of these "recognized principles," and the edition of 1911 contains 450 pages of text. The Association should recognize its responsibility for guarding the quality of the work which supports our recommended practice.

The growth of the membership in fifteen years has been gradual and consistent. The constitution definitely defines the qualifications of members, and the standard requirements for entrance result in the selection only of men who possess large education and experience. From about 200 in 1900, the membership has increased to about 1,200 in 1914. It is confidently expected that within ten years the total enrollment will be 2,000. Some of our members feel that it would be safe and profitable to admit to full membership certain classes of engineers who are not connected in an official capacity with railway corporations. The merits of this proposition will no doubt receive attention during the next few years. An increase in membership is greatly to be desired, in order that the revenues of the Association may be increased. However, the question of money is secondary to that of the qualifications of those who are admitted to full membership.

The work of the Association should be broadened to include the consideration of all elements entering into the fixed physical property. The increasing importance of the telephone in the railway business suggests the advisability of opening our membership to engineers who are expert in the design and construction of telegraph and telephone lines. When a sufficient number of these men join the Association, a special committee on this branch of railroading should be appointed.

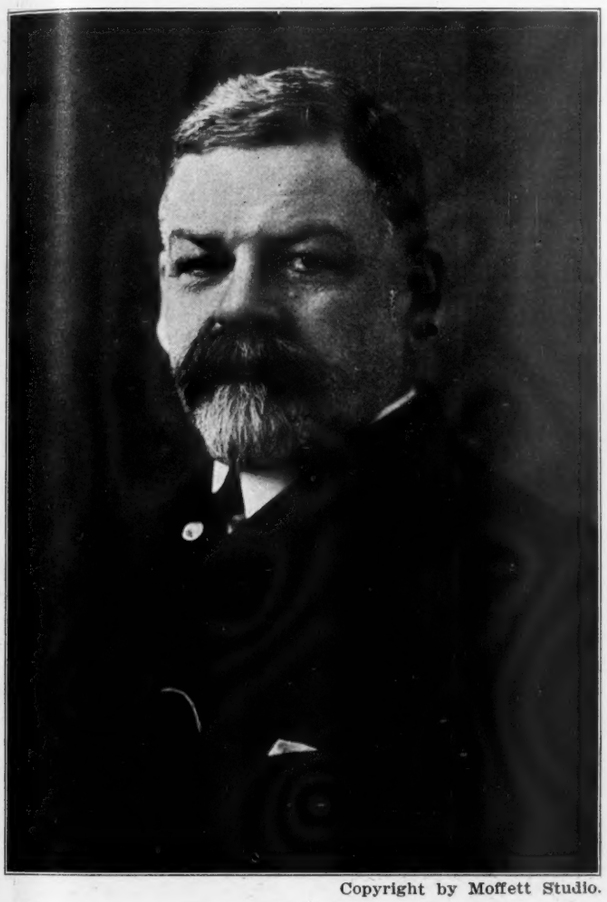
The work of our Committee is now recognized by all steam railway carriers, all State Governments and all Federal Governments in America. The improvement of the quality of rails is one of first importance. It is necessary to prosecute the work continuously, and during the past five years the Association has had the practical assistance of the American Railway Association. In order to make more rapid progress in the investigation of the rail problem, the special engineer who has been working under the direction of the rail committee will be furnished with one expert assistant.

The Board of Direction has appointed a special committee to cooperate with a similar committee from the American Society of Civil Engineers to conduct a series of tests to determine stresses in track. The sum of $10,000 has been tendered to the American Railway Engineering Association by the United States Steel Corporation to aid in defraying the cost of the experiments which will be undertaken. The personnel of our special committee is as follows: A. N. Talbot, chairman, W. M. Dawley, vice-chairman, A. S. Baldwin, J. B. Berry, G. H. Bremner, H. E. Hale, John Brunner, W. J. Burton, C. S. Churchill, W. C. Cushing, Dr. P. H. Dudley, Emil Gerber, J. B. Jenkins, Geo. W. Kittredge, P. M. LaBach, Wm. McNab, G. J. Ray, F. E. Turneaure, J. E. Willoughby. The committee from the A. S. C. E. is the same with the exception of Messrs. Dawley, Hale, LaBach, Dudley and Jenkins.

The civil engineering departments of railways generally include mechanical as well as civil engineers. Our constitution states that "a member shall be either a civil engineer, a mechanical engineer, an electrical engineer,

etc., etc." Special effort on the part of our members will result in many mechanical engineers making application for admittance, and the work of the Association will be strengthened and broadened by the selection of a special committee to consider the mechanical features in connection with the fixed physical property.

The committee on Records and Accounts during the next five years will consider many important subjects relating to valuation. Greater uniformity of practice in connection with the preparation of engineering records



Copyright by Moffett Studio.

W. B. STOREY, JR., First Vice-President.

is likely to result from the extension of the powers of the Federal Commission. Our committee will find it profitable to review the entire question of fundamental records and to determine the forms and methods which make for uniformity.

The work of the committee should be extended into the field of engineering accounting. The entire series of classifications of accounts of the Interstate Commerce Commission should be carefully studied with reference to both form and principle, and the Association should take a leading part in the discussion of any future changes in these classifications. Engineers have been very backward in taking up the study of cost accounting, but the time has now arrived when the exigencies of the situation demand that engineers in charge of construction and maintenance shall perfect their knowledge of the principles which underlie this important subject.

The Board of Direction last year requested the committee on Rules and Organization to begin the study of the science of organization, and report to the Board of Direction how this study can be made profitable to the Association. The committee has presented to the Board a most excellent report, which will probably be printed in the April bulletin and distributed to the members. The initial report of the committee justifies the hope of the board that this subject can be considered profitably from the standpoint of principle with the greatest benefit to the Association. Efficiency and economy presuppose correct organization. Scientific management is nothing more than the application of correct principles to the management of business, and the study of the principles of organization will be of pronounced educational value to our members.

SIGNALS.

At the beginning of the Twentieth Century the efforts of signal experts to establish the economy of signal installations were rewarded. Signals were found to safeguard and facilitate traffic. Each year more and more progress has been made, until to-day signalling is recognized as a prominent factor in successful operation. The number of automatic block signals and interlocking levers has increased by leaps and bounds, and will continue to increase for many years to come. The mileage of manual block has increased from about 24,000 to 64,555 miles, and that of automatic block from 2,300 to 22,200. Power interlocking has supplanted mechanical machines at nearly all large plants, and the successful operation of such terminals as the Pennsylvania and New York Central at New York, the joint terminals at Boston, St. Louis, and Washington, and that of the North-Western at Chicago, are due very largely to the development of power interlocking. Three-position signals, electric route-locking, annunciators, electric detector locking as a substitute for detector bars, illuminated track models, and signals working in the upper quadrant, are among the

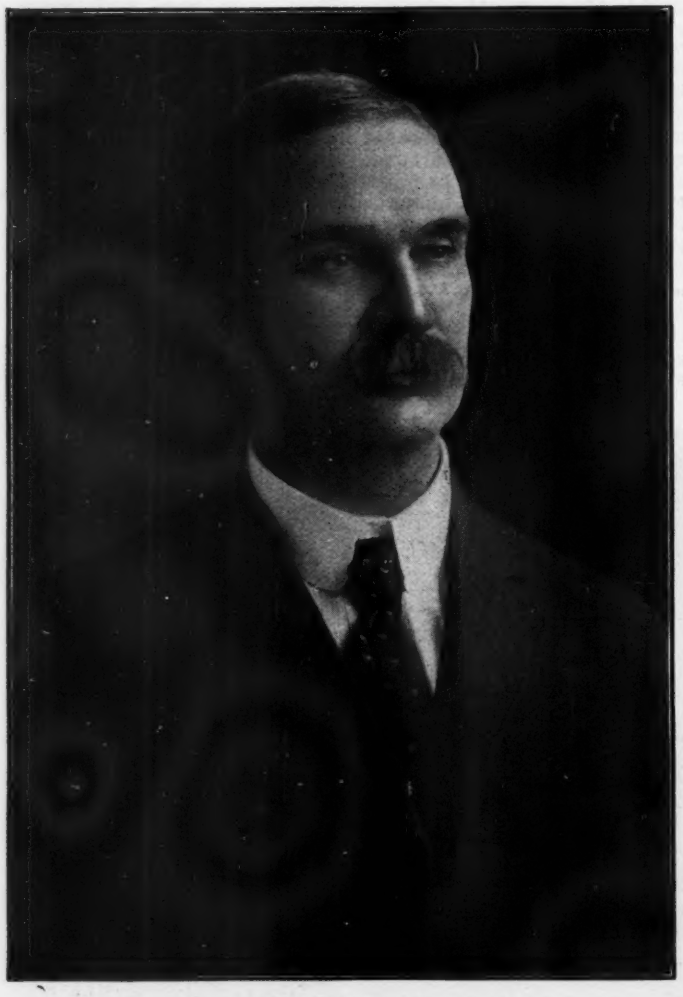
ROBERT TRIMBLE, Second Vice-President.

many important improvements which have become indispensable during the life of our Association.

TRACK.

The American Railway Association has requested our Association to cooperate jointly with the Master Mechanics' Association and the Association of Chilled Car Wheel Manufacturers, to determine the question of proper throat clearance for frogs, guard rails and crossings. The work has been assigned to the committee on Track.

Alaska comprises an area equal to one-fifth of that of the United States. Congress has decided to build not exceeding 1,000 miles of modern railway at an expense not to exceed $35,000,000. The act of Congress permits the President either to operate the road when completed, or to lease it to a private company. The release of the natural resources of Alaska now owned by the Government and the encouragement of private enterprise in the employment of these resources under conditions of gov-



G. H. BREMNER, Treasurer.

ernmental regulation which shall fully safeguard the public interests constitutes one of our greatest national problems. The consideration of this new railway marks an epoch in the history of our country in respect to the construction and operation of railways by the Government, but conditions are favorable for the experiment and the results will show whether the new policy of public instead of private ownership is best.

During the fifteen years' life of our Association, the Dominion of Canada has made most marvelous progress, which is represented by the rapid growth of its principal transcontinental railway systems. The Grand Trunk Pacific Railway will be completed in 1914. The track is now laid continuous, except over the Quebec bridge, from Moncton, New Brunswick, to Winnipeg, Manitoba, a distance of 1,804 miles, and extends westerly across the Rocky Mountains to a point 1,280 miles west of Winnipeg, making a total continuous mileage from Moncton of 3,084 miles. Tracklaying has been completed from Prince Rupert on the Pacific Ocean, easterly for 325 miles. It is expected that the rails will be connected between the Atlantic and Pacific Oceans during the coming summer.

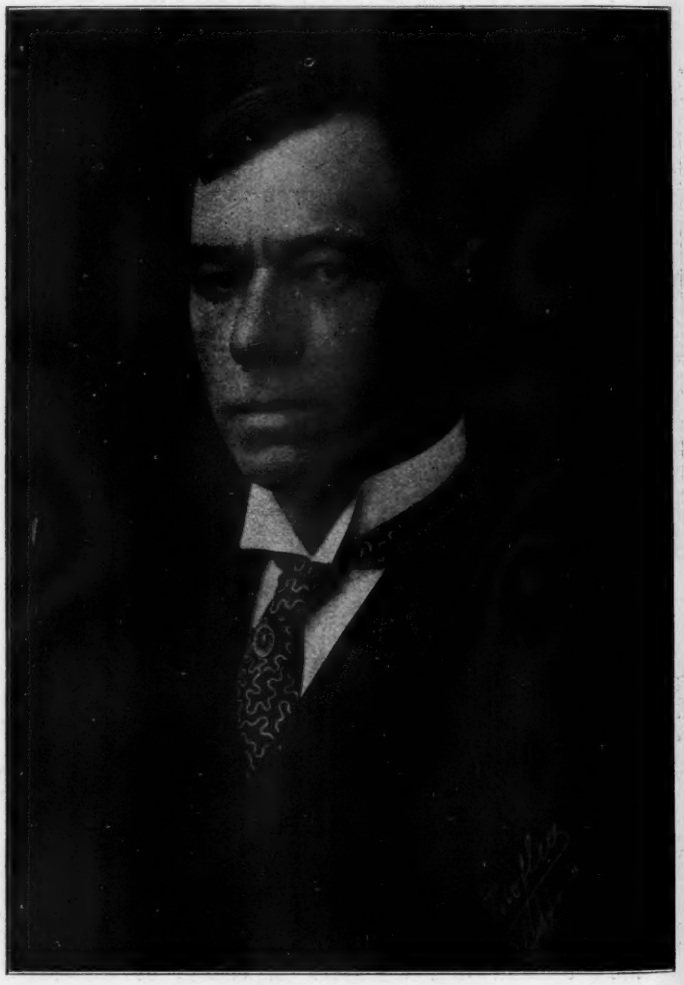
DEVELOPMENT OF ELECTRIC TRACTION DURING 15 YEARS—1899 TO 1914.

The theoretical possibilities of electric traction were recognized so early as 1830 by Thomas Davenport of Vermont. Following his general theories, others subsequently made experimental demonstrations of electrical car operation. Dynamos and rotary electric motors were first produced in the early sixties. In 1887 Frank J. Sprague, who had already made one or two successful Electric Railway installations, undertook the then herculean task of electrifying the entire street railway system of Richmond, Va., which project was completed in February, 1888. There were then about a dozen small electric railway systems operated in this country, the most extensive of which had about seven miles of track.

So early as 1891, John F. Wallace, then chief engineer of the Illinois Central, seriously contemplated, and negotiated for the electrification of his company's Suburban service at Chicago, which has not yet been undertaken. In 1892, the Baltimore & Ohio Railroad closed its contract for the electrification of its belt line tunnel at Baltimore, the electrification of which was not completed until 1895.

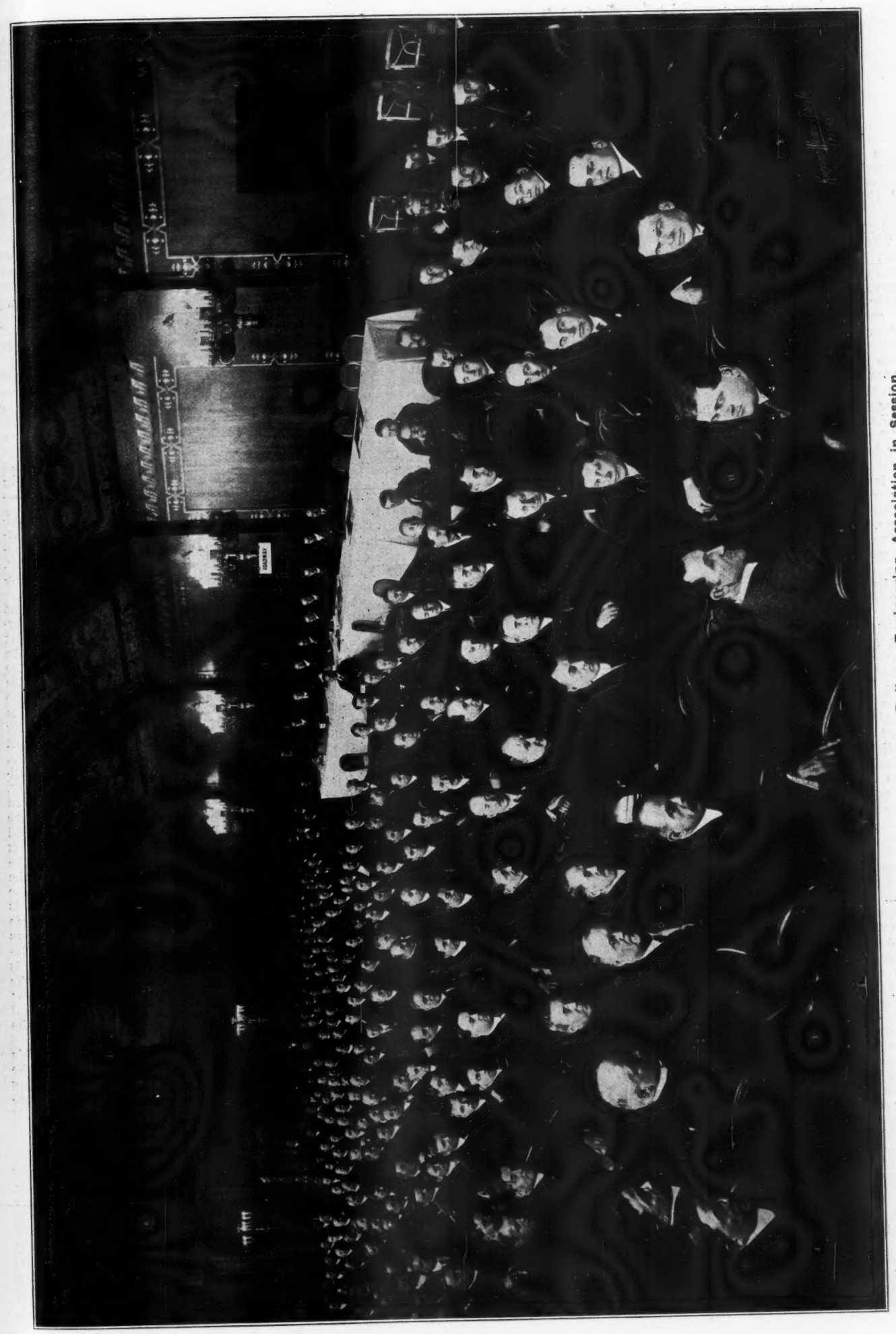
In 1896 the New York, New Haven & Hartford electrified its Nantasket Beach line near Boston; and in 1897 and 1898 about 40 miles of its branch lines in the vicinity of Hartford, in both instances using heavily equipped motor cars for train haulage. In 1897 Frank J. Sprague revolutionized all theories previously held on train operation by the invention of his multiple unit system of train control, the operative possibilities of which are probably not yet fully appreciated. The South Side Elevated Railroad of Chicago was thus equipped and operated in 1898.

In 1900 the total track mileage of all electric railways in this country was not far from 20,500 of which, as



E. H. FRITCH, Secretary.

already stated not over 1,000 miles was strictly interurban in its character. The present track mileage of all American Electric Railways is about 45,000, of which approximately 20,000 miles is Interurban, and on much of which trackage a service comparable to that of steam railroads is operated. At the commencement of 1900 there were not to exceed six types of electric locomotive, numbering not above 20, operated in this country which were of sufficient capacity to be compared with steam locomotives then in use. There are now in America approxim-



Convention of the American Railway Engineering Association in Session.

ately 151 types representing 463 electric locomotives in operation, and 59 on order. Of these approximately 160 are for single or split phase A. C. operation; 4 for three phase, and about 100 for D. C. operation at 1,200 volts or higher potential. Of the last about 30 are for operation at 2,400 volts D. C. Those locomotives not in the classes enumerated are for 600 volt operation.

In 1900 about ten 600 volt D. C. locomotives were in operation upon various sections of European Steam Railroads, as were 12 three phase. Up to the present European electrical manufacturers have produced 80 types of electric locomotives to be used by steam railroads, representing 262 machines now in service, and 148 on order. Of this total probably a third are three phase; about one-half single phase and the remainder D. C. Among these last are some high tension machines.

The form of electric traction development since 1900 that has been the most extensive; has replaced far more steam locomotives than has been done by electric locomotives; and that has created a class of railways closely analogous to steam roads, so far as their passenger traffic is concerned, is through the use of heavy cars with a motor capacity of from 300 H.P. to 600 H.P. each. Probably over 20,000 cars of this general description have been placed in service since 1900. These are operated under such widely varying conditions of service as is represented by caring for the suburban service of the New York Central, Long Island and Southern Pacific railroads.

The general tendency in what is termed single phase development is now toward its material modification, the most important form of which is termed split phase, such as is now being installed on the Norfolk & Western. In the development of high tension D. C. operation experiments are being made with as high a potential as 5,000 volts.

Experiments are in progress also with what are termed mercury arc rectifier systems of operation. These are of two different forms.

First: Through the installation of the mercury arc rectifier device of larger sizes than have heretofore been in use, to replace the rotary converters or motor generators which now convert A. C. into D. C. current at substations; and it is hoped by all and expected by a few engineers that practically the same conversion can thus be accomplished without the introduction of moving mechanical parts. This method, if a success, would simplify and reduce the costs of substation operation, but the system of transmission and distribution, as well as the rolling stock equipment would remain practically the same as on D. C. roads of the present.

Second: Through the installation of mercury arc rectifiers upon electric locomotives and motor cars, endeavor to secure all the advantages of A. C. transmission and distribution; also to avoid the use of substations for current conversion, and at the same time secure the well recognized advantages in operation of D. C. motors and control. Attractive as are the theories involved in both forms of the experiment, apparently great technical difficulties stand in the way of their practical realization.

As is generally known, the Pennsylvania has already arranged for the electrification of a goodly portion of its suburban lines in the vicinity of Philadelphia. The Chicago, Milwaukee & St. Paul has contracted for electrical power to operate approximately 450 miles of its main line and are about to order the electrical equipment therefor. Several other important electrification projects are in immediate contemplation by American railway systems, and electrified sections of railroads are being extended. Excluding elevated and other local railroad electrifications, about 1,750 miles of steam railroad track has already been electrified and at least 900 miles more has been definitely decided upon; while the electrification of still another 1,000 miles or more is seriously contemplated. The broad future of railroad electrification is dependent upon its thorough demonstration of great economic advantages over steam. If these are shown nothing can of course prevent its ultimate general introduction. If these are not so demonstrated, its limitations as regards introduction will soon be reached.

VALUATION OF COMMON CARRIERS.

On March 1, 1913, Congress passed the Valuation Act, which is Section 19a of the "Act to Regulate Commerce." The Interstate Commerce Commission is authorized and empowered to make a valuation of all common carriers of the United States. The term "common carrier" includes steam railways, electric railways, water lines, express companies, sleeping car companies, pipe line companies, telegraph lines, and telephone lines. The problem of valuation is one of gigantic proportions, because it deals with property which is capitalized at about $20,000,000,000. There is no precedent in any country in the world for this important work, whose purpose is to establish a basis for the regulation of rates. In no other country have valuations ever been made for purposes of regulation. It therefore appears that a new work has been undertaken which will accomplish results of the greatest interest to the people. Important social and economic changes may follow.

The magnitude of the valuation problem is reflected in statistics showing the growth of the railways during the past fifteen years, as follows:

DEVELOPMENT OF RAILWAYS IN THE UNITED STATES

Subject	1900	1911	Gain %
Miles of railway	193,346	244,180	26.3
Miles of track	258,784	362,824	40.2
Number of operating roads	1,067	1,312	22.9
Number of locomotives	37,663	61,327	62.8
Number of cars in passenger service	34,713	49,818	43.5
Number of cars in freight service	1,365,531	2,195,511	60.8
Number of employees	1,017,653	1,669,809	64.1
Compensation of employees, yearly	$577,264,841	$1,208,466,470	109.3
Average yearly pay for employee	$567.25	$723.71	27.5
Number of passengers carried	576,931,251	997,409,882	72.8
Tons of freight carried	583,351,351	1,003,053,893	71.9
Average number of tons per train	270.86	383.10	41.4
Capital stock	$5,845,579,593	$8,470,717,611	44.9
Funded debt	$5,645,455,367	$10,738,217,470	91.9

Valuation is a problem involving (1) the law; (2) engineering; (3) accounting; (4) economics. First, the corporation is organized under the law, followed by the construction of the property, the accounting for its cost, and finally, the consideration of the results of its operation.

In 1898, at about the time of the first meeting of those eminent engineers who conceived and organized the American Railway Engineering Association, the Supreme Court of the United States handed down its decision in the Nebraska Rate Case, affirming the principle that "The basis of all calculations as to the reasonableness of rates must be the fair value of the property being used for the public convenience. What the company is entitled to is a fair return upon the value of that which it employs for the public convenience." In the opinion of the Circuit Court in the Nebraska Rate Case, Justice Brewer said, "Now, if the public was seeking to take title to the railroad by condemnation, the present value of the property, and not the cost, is that which it would have to pay. In like manner, it may be argued that when the legislature assumes the right to reduce rates, the rates so reduced cannot be adjudged unreasonable if under them there is earned by the railroad company a fair interest on the actual value of the property." The Supreme Court in the Consolidated Gas Case, in 1909, said, "We concur with the court below, in holding that the value of the property is to be determined as of the time when the injury is made regarding the rates. If the property which legally enters into the consideration of the question of rates has increased in value since it was acquired the company is entitled to the benefit of such increase." In June, 1913, the Supreme Court decided the Minnesota Rate Case, and said: "The property is held in private ownership, and it is that property, and not the original cost of it, of which the owner may not be deprived without due process of law.

A duty will rest upon engineers in connection with this valuation work, because it is necessary to determine the cost of reproduction, which is distinctively an engineering problem. Congress has ordered, "That the Interstate Commerce Commission shall investigate, ascertain, and report the value of all the property owned or used by every common carrier subject to the provisions of this Act. The Commission shall make an inventory which shall list the property of every common carrier * * * in detail, and show the value thereof, * * * and shall classify the physical property, as nearly as practicable, in conformity with the classification of expenditures for road and equipment as prescribed by the Interstate Commerce Commission." The Commission is required to ascertain and report in detail as to each piece of property (1) the original cost to date; (2) the cost of reproduction new; (3) the cost of production less depreciation; and (4) in like manner, other values and elements of value.

It is probable that the original cost of many railways cannot be determined, because records have been lost or destroyed. Roads built before the passage of the Hepburn Act, in 1906, kept their accounts in accordance with a multitude of accounting systems, and charges to capital were determined by a variety of principles. Uniformity of method in accounting was unknown, and where additions and betterments were made, the cost was divided between operation and investment according to the economic principle which was adopted by a particular carrier. Railways constructed since July 1, 1907, have been required by the Interstate Commerce Commission to report their investments in accordance with a uniform system of accounts, by which charges to capital account were determined on the basis of a uniform principle. The original cost of these roads can be determined. The determination of the "original cost to date" of railways, whether built before or after the passage of the Hepburn law, is largely an accounting problem. However, many difficulties will arise in connection with the preparation of a final inventory, and it is probable that a portion of the responsibility will rest on engineers.

The Commission is required to determine the cost of the reproduction of railways just as if they were being built anew. The act specifically requires that a detailed inventory shall be prepared, and that the units of the property shall be classified. In order to accomplish this purpose, it will be necessary to remeasure the units of the railways of the country, which, at the present time, amount to about 250,000 miles of road. This is a task of gigantic proportions, involving, as it does, an effort to determine the extent of properties which are variously estimated to be worth from 15 to 20 billions of dollars. The work of estimating the "cost of reproduction new" is essentially an engineering problem, and will require the best energies of the engineers of this country. Many doubtful questions are involved, and since there is no precedent for this work in the history of Europe or America, it will be advisable for such organizations as the American Railway Engineering Association to carefully analyze this problem and study the fundamental principles and factors which should govern.

The depreciation problem is complex and has a bearing on the determination of "fair value." Considerable attention has been given to the depreciation problem in connection with water works, gas plants, and other municipal utilities; but in so far as the steam railroad business is concerned, the principle of depreciation has not heretofore been generally recognized in the keeping of investment accounts. The Supreme Court has decided that depreciation shall be deducted from the cost of reproduction, but there are various methods for computing the amount, and the problem now is to determine the method which will yield a result which will be just and true and fair. This work will involve an extended study on the part of engineers, economists, attorneys, and accountants.

Congress has recognized the fact that valuation is a complex problem, and has ordered that every feature of the business of common carriers shall be investigated and studied in order that "other values, and elements of value, if any, of the property," shall be reported. This work opens up a large field for valuation experts.

Congress has provided that, "Upon the completion of the valuation herein provided for, the Commission shall thereafter in like manner keep itself informed of all extensions or improvements or other changes in the condition and value of the property of all common carriers, and shall ascertain the value thereof, and shall, from time to time, revise and correct its valuations, showing such revision and correction classified, as a whole and separately in each of the several states and territories and the District of Columbia, which valuations, both original and corrected, shall be tentative valuations and shall be reported to Congress at the beginning of each regular session." All common carriers will be required to report to the Interstate Commerce Commission the details of their investment in each and every extension, improvement, or change, including deductions incident to property which is retired or abandoned. This is a work of great magnitude for construction and maintenance engineers, on whom will rest the responsibility of determining what units of an improvement are to be charged to investment and what units must be charged to operating expenses on account of replacement. Engineering accountants will be required in the offices of original record, and the field of usefulness for the engineer who understands the principles of accounting will be greatly enlarged. Cost accounting is an important branch of railway engineering, and this Association will be justified in requiring its various committees to study the fundamental principles of economics which must be followed in order that the record of cost may be true and fair and just.

The Board of Direction has considered the appointment of a special committee on valuation of railways, but no final action has been taken. In view of the importance of the work, the Board has arranged to publish a bibliography on the subject, which will be kept up to date by supplements issued from time to time. Many of the fundamental principles and factors entering into valuation remain to be determined, and the high standing of this Association makes it imperative that the membership should lead in the discussion of this question during the next few years. It seems desirable for the Association to appoint a special committee to consider the broad fundamental principles which should be adopted.

Reports of Secretary and Treasurer.

Balance cash on hand December 31, 1912		$10,745.26
Consisting of:		
Cash in bank	$ 5,539.20	
Six railway bonds	5,206.06	
Total	$10,745.26	
Receipts during the year 1913:		
From members	$13,677.75	
From sales of publications, advertising, etc.	5,577.84	
From Am. Ry. Assn.—Rail Committee expenses	5,627.00	
From interest on bank balance	112.61	
From interest on investments	320.00	
Miscellaneous	563.35	
Total receipts in 1913	$25,878.55	
Expenditures during 1913	22,347.07	
Excess of receipts over expenditures	$ 3,531.48	3,531.48
Balance on hand December 31, 1913		$14,276.74
Consisting of:		
Six railway bonds, par value $1,000 each, at cost	$ 5,206.06	
Four Lincoln Park bonds, par value $1,000 each, at cost	4,004.27	
Cash in Standard Trust and Savings Bank	5,066.41	
Total	$14,276.74	

RULES AND ORGANIZATION

The committee worked during the past year under the following instructions:

(1) Review rules and instructions heretofore adopted by the Association and recommend such changes and additions thereto as may seem desirable.

(2) Formulate rules for the guidance of field parties.
- (a) When making preliminary surveys for railroad location.
- (b) When making location surveys.
- (c) When in charge of construction.

(3) Begin the study of the science of organization, and report to the Board of Direction how this study can be made profitable to the Association.

Under the first instruction the committee recommended that the following revisions and additions be made in the General Rules for the Government of the Employes of the Maintenance of Way Department, heretofore adopted by the Association:

Add to Rule 4 of "General Notice" the words: "They must familiarize themselves with the safety regulations of the road," making the rule to read:

"Employes must exercise care and watchfulness to prevent injury to themselves, other employes and the public, and to prevent damage to property. In case of doubt, they must take the safe course. They must know that all tools and appliances are in safe condition before using. They must move away from tracks upon approach and during passage of trains, and, so far as practicable, prevent the public from walking on tracks or otherwise trespassing on the right-of-way. They must familiarize themselves with the safety regulations of the road."

Revise Rule 13 under Rules Governing Track Supervisors, Supervisors of Structures and Signal Supervisors, as follows:

Present Rule: "They must know that foremen are provided with the rules, circulars, forms and special instructions pertaining

to their duties, and that they fully understand and comply with them."

Proposed Rule: "They must know that foremen are provided with the rules, circulars, forms, special instructions and safety regulations pertaining to their duties, and that they fully understand and comply with them."

Add a rule under Rules Governing Foremen, to be under Track Foremen No. 18, Bridge and Building Foremen No. 11, and Signal Foremen No. 12, to read:

"They must thoroughly understand the rules, circulars, forms, special instructions and safety regulations pertaining to their duties, and see that they are complied with."

Add to Rule 17 under Track Foremen:

"They must give special attention to drainage through interlocking plants and where track circuits are used,"

making it read:

"They must keep all interlocking pipe lines and trunking free from grass and weeds, and all switches, frogs and movable parts of interlocking plants free from snow, ice and other obstructions. They must give special attention to drainage through interlocking plants and where track circuits are used."

Under the second instruction considerable progress was reported in the collection and tabulation of rules and instructions of the various roads bearing on preliminary and location surveys and construction. It is the intention

G. D. BROOKE,

Chairman Committee on Rules and Organization.

to continue the work during the ensuing year, with the expectation of compiling an extensive set of instructions governing parties engaged in the work described under this instruction. The following general rules were presented with the recommendation that they be printed in the manual:

GENERAL RULES FOR THE GOVERNMENT OF EMPLOYES OF THE CONSTRUCTION DEPARTMENT.

General Notice.

(1) To enter or remain in the service is an assurance of willingness to obey the rules.

(2) The service demands the faithful, intelligent and courteous discharge of duty.

(3) Obedience to the rules is essential to the safety of passengers and employes, and to the protection of property.

(4) Employes must exercise care and watchfulness to prevent injury to themselves, other employes and the public, and to prevent damage to property. In case of doubt they must take the safe course. They must know that all tools and appliances are in safe condition before using. The must move away from tracks upon approach and during passage for trains, and, so far as practicable, prevent the public from walking on tracks or otherwise trespassing on the right-of-way. They must familiarize themselves with the safety regulations of the road.

(5) Employes must do all in their power to prevent accidents, even though in so doing they occasionally perform the duties of others.

(6) Co-operation is required between all employes whose work or duties may be jointly affected.

(7) Anything that interferes with the safe passage of trains at full speed is an obstruction.

(8) Employes in accepting employment assume its risks.

(9) To obtain promotion, capacity must be shown for greater responsibility.

(10) Employes must not absent themselves from duty, exchange duties with others or engage substitutes.

(11) Employes must conduct themselves properly at all times. They will be courteous to fellow-employes and patrons of the road.

Organization.

(1) The Construction Department in each ..... (Title) (District or etc.).....is in charge of the..... who will report to and receive instructions from the (Title) .....

(2) The work of the department will be sub-divided under the following heads:

Preliminary Surveys,	Chief of Party ..... (or Title)
Location Surveys,	Chief of Party ..... (or Title)
Construction.	Resident Engineer.

Rules Governing Chiefs of Party on Preliminary and Location Surveys and Resident Engineers.

(1) Chiefs of Party / Resident Engineers } will report to and receive instructions from the ..... (Title)

(2) They are responsible for the prosecution of the work in accordance with the general rules and special instructions, and will make such periodical reports as are required.

(3) They shall keep their parties up to the required strength and report any prospective vacancies to the (Title) .....

(4) They are responsible for the proper conduct of the members of their parties and must know that each man is competent to do the work required of him.

(5) They shall conform to the prescribed standards and plans in the execution of work under their charge.

(6) They must keep their parties supplied with the instruments and material necessary for the efficient performance of their work, and see that these are properly used and cared for.

(7) They must know that instruments are kept in proper adjustment and that the prescribed accuracy is attained in all their work.

(8) They must not give out information as to the object or character of their work and must refer all inquiries to the (Title) .....

(9) They shall keep themselves informed in regard to the work of other survey parties operating in their districts and report to the (Title) ..... anything that will have an influence on their work.

(10) They will assume immediate charge of their parties when running lines and staking out important work.

(11) They must know that their parties are provided with the rules, standards, circulars, forms, special instructions and safety regulations pertaining to their work, and that they are fully understood by the men to whom they apply.

(12) They shall keep a daily journal of the movements of their parties and the work done, and will enter therein current items of information of which it is advisable to keep record.

Under the third instruction the committee reported progress in the study of the science of organization, and that a report has been made to the Board of Direction as directed in the instruction.

For next year's work the committee recommended the following instructions:

(1) Review rules and instructions heretofore adopted by the Association and recommend such changes and additions thereto as may seem desirable.

(2) Formulate rules for the guidance of Maintenance of Way Department pertaining to safety.

(3) Continue the formulation of rules for the guidance of field parties:

(a) When making preliminary surveys.
(b) When making location surveys.
(c) When in charge of construction.

(4) Continue the study of the Science of Organization.

G. D. Brooke (B. & O.), Chairman; F. D. Anthony (D. & H.), Vice-Chairman; R. P. Black (K. & M.), J. B. Carothers (B. & O.), S. E. Coombs (N. Y. C. & H. R.), C. Dougherty (Q. & C.), K. Hanger (C. R. I. & P.), B. Herman (Southern), Jos. Mullen (C. C. C. & St. L.), E. T. Reisler (L. V.), Committee.

Discussion on Rules and Organizations.

G. D. Brooke, chairman, read the report by rules.

H. M. Church (B. & O.): I would like to ask you to take into consideration the fourth sentence in new rule 4, where it says: "They must move away from the tracks upon approach and during passage of trains, and, so far as practicable, prevent the public from walking on tracks or otherwise trespassing on the right-of-way." It does not occur to me that that quite covers the situation. I move that sentence be changed to read as follows: "On approach of trains employes who are working on and about tracks must move to a place of safety, and, so far as practicable, prevent the public from walking on tracks or otherwise trespassing on the right-of-way, and also warn and serve notice on those habitually trespassing." I think at places where there is constant trespassing on railroads, some notice should be given.

Mr. Brooke: The view of the committee is that that would be covered in rules which follow, or more specific rules by individual companies.

(The motion made by Mr. Church was put to vote and lost.)

C. E. Lindsay (N. Y. C. & H. R.): Will the committee omit the words at the end of the proposed rule "Of the Road?"

The President: The committee will accept that suggestion.

(The amendment to Rule IV was then put to vote and adopted. Rules 13 and 18 were also adopted as revised.)

H. R. Safford (G. T.): It seems to me in view of the fact that there must be complete co-operation between the section force and the men in charge of the interlocking plant, and the fact that the interlocking man must not be relieved from the responsibility for seeing that this work is done, an addition to rule 17 expressing that co-operation would be a valuable thing in order that it may not be understood to relieve the local interlocking plant force from some of that responsibility.

Mr. Brooke: The committee thinks that such an arrangement would probably mean a division of authority over the section foreman's force, putting some of his men at certain times under the charge of the signal maintainer, who might be inclined to carry his authority too far. These rules apply only to track foremen and rules which will probably be written later, governing maintainers, would probably cover that point.

Mr. Safford: The principal point was there should be something to require co-operative effort between the section foreman and the interlocking force.

Mr. Brooke: The committee will take that point into consideration in connection with next year's work.

(A motion to amend Rule 17 was carried.)

William McNab (G. T.): I think in the general notice under general rules for the government of employes of the construction department we should be consistent. Rules 4 and 11 are not expressed in quite the same terms. Rule 4 states that employes must exercise care and watchfulness to prevent injuries to themselves, other employes and the public. Rule 11 says that employes must be courteous to fellow-employes and patrons of the road. I think if the committee would change that to "fellow employes and the public" it would be in better form, as I would not like to see the Association go on record as limiting the range of courtesy.

Mr. Brooke: The committee will accept that suggestion.

(On motion the rules under "General Notice" as amended were adopted.)

C. E. Lindsay (N. Y. C. & H. R.): Will the committee accept the removal of the word "periodical" in Rule 2, under "Rules Governing Chiefs of Party?"

Mr. Brooke: Yes, we will accept that.

Mr. Lindsay: It seems to me that in Rule 4 the chief of the party would be as responsible for the improper conduct of the party as for the proper conduct of the party. Will the committee accept the addition of the word "improper?"

Mr. Brooke: The committee will accept Mr. Lindsay's suggestion.

(Mr. Brooke then read Rules 5, 6, 7, 8, 9, 10, 11 and 12.)

J. B. Berry (Rock Island): In Rule 5 the committee should put the word "instruction" after the word "prescribed."

Mr. Brooke: The committee will accept that revision and insert the word "instructions."

Mr. Stewart: I move that Rule 10 be eliminated and that Rules 11 and 12, as written in the report, be made to read Rules 10 and 11. My reason for that is that I think we should not bind the chief of party to such rigid lines as are here required.

The President: The committee joins in the approval of that change. (The rules under "Organization and Rules Governing the Chief of Party" were then adopted.)

SIGNALS AND INTERLOCKING

The committee submitted the same report on "Economics of Labor in Signal Maintenance" as was submitted by Committee 1, of the Railway Signal Association. Under the subject, "Requirements for Switch Indicators," the committee reported progress and asked that the subject be continued, and promised to make a final report next year. The committee deems it inadvisable for the association to undertake work in connection with the subject of "Switch Indicators" until the report is made by the American Railway Association.

The report on track circuits consisted of various tests showing the conductivity of creosote and creosote-treated ties as well as the effect of ballast and bonding conditions. This report was the same as that of Committee 1 of the Railway Signal Association.

The committee recommended that the symbols for signals and interlocking now shown in the manual be changed in

T. S. STEVENS,
Chairman Committee on Signals and Interlocking.

accordance with the standard symbols adopted by letter ballot by the Railway Signal Association after their annual convention in 1914. These symbols are shown in the committee's report and on pages 499 to 510 of the 1911 Railway Signal Association proceedings.

Appendix "A" consists of rule governing the construction, maintenance and operation of interlocking plants, recently adopted by the states of Wisconsin, Illinois, Indiana, Minnesota, Missouri and Iowa. These rules are published on page 257 of The Signal Engineer for August, 1913, and were revised by the conference committee on October 3. The sections of these rules which were changed were printed on page 354 of The Signal Engineer for November, 1913. These rules are submitted as information to be published in the literature, but not included in the manual.

Thos. S. Stevens, Chairman (A. T. & S. F.), C. C. Anthony (P. R. R.), Azel Ames (Kerite Co.), M. H. Hovey (Consulting Signal Engineer), H. S. Balliet (G. C. T., New York), A. S. Ingalls (L. S. & M. S.), W. B. Causey (C. G. W.), J. C. Mock (M. C.), C. A. Christofferson (N. P.), J. A. Peabody (C. & N. W.), C. E. Denney (L. S. & M. S.), A. H. Rudd (P. R. R.), W. J. Eck (Southern), W. B. Scott (S. P.), W. H. Elliott (N. Y. C. & H. R.), A. G. Shaver (C. R. I. & P.), and G. E. Ellis (K. C. T.), Committee.

Discussion on Signals and Interlocking.

The report was presented by C. C. Anthony, vice-chairman.

L. C. Fritch: It is quite important in view of the extended use of treated ties that some definite recommendation should

be made as to the length of track circuits when treated ties are used. The committee has gone into this subject very exhaustively, and it might be well for them to give us some recommendation as to what to do with our track circuits in case a certain class of treated ties are used and a certain number of ties per mile are used.

Mr. Anthony: The committee will be glad to take up that subject in the work of next year.

C. E. Lindsay: The subject of track circuits is very important. We found in certain conditions that the accumulation of brake shoe dust on the track has a greater influence on the signals than the dirty condition of the track, the ballast, or the use of the special tie. I call that to the attention of the committee. I have compared the devices shown on pages 81 and following and have found some differences between those shown here and those shown in another bulletin, for instance, in regard to mile posts. There are some differences which ought to be reconciled before this is substituted for the matter in the Manual.

Mr. Church: This committee should confer with the committee on records and accounts and reconcile any differences which may exist in these symbols as submitted here, and those which that committee submits for adoption this year.

The President: The differences between the recommendations of the Signal Committee and the recommendations of the Records and Account Committee can be reconciled without any difficulty. The motion is that the Manual be amended and that the symbols on pages 81 to 92, subject to such modifications as are necessary in order to harmonize the recommendations of the Committee on Signals with those of the Committee on Records and Accounts, be adopted.

(The motion was carried.)

L. C. Fritch: The rules under Appendix A have been adopted by the railroads in all those states, have been found to be very reasonable and I believe we could accept them without any reservation.

The President: You will notice that the committee submits for the information of members some observations respecting economics of labor in signal maintenance. The membership should express itself in reference to this study, because it is one which, in my judgment, should be prosecuted continuously for several years to come.

H. R. Safford (G. T.): It seems to me that there is a good deal that can be discussed between the Signal Committee and the Track Committee. We made inquiry as to the extent to which economics of labor had been put into effect by the railroads and the information that we have so far received is that combined work has been taken in hand by two or three railroads, and in the particular instance in mind it has been in connection with the maintenance of the signal system and other work in connection with signals.

The President: When we outlined our committee work two years ago we included this subject of economics in labor. Previously but very little consideration had been given to this broad question. We all know that about 55 per cent., and in some places between 50 and 60 per cent., of the expenses of the railway are consumed in the labor charges, and the importance of this question is reflected by those statistics. If the engineer is ever going to assert himself in connection with the broader questions of the railway business, he will have to study the question of economics. This subject has been defined as the social science of business and it does seem to me that the object of our Association is not alone to consider the design of appliances, respecting the construction and maintenance of railways, but it is as well to consider the broader economic features. The engineer is peculiarly educated and fitted for making this study.

YARDS AND TERMINALS

The Board of Direction assigned the following subjects:

(1) Report on typical situation plans of passenger stations, of both through and stub types, with critical analysis of working capacity, and include a review of the different methods of estimating their capacity.

(2) Report on developments in the handling of freight by mechanical means.

(3) Report on developments in the design and operation of hump yards.

(4) Report on track scales.

TYPICAL SITUATION PLANS OF PASSENGER STATIONS.

The work on this subject was industriously prosecuted by the members of the sub-committee. Arrangements are being completed for putting in use the diagrams submitted by the committee in its last report in some large terminals. This had not been carried to the extent which would allow a report to be made and the committee, therefore, desired that the subject be carried over until its next report.

DEVELOPMENTS IN THE HANDLING OF FREIGHT BY MECHANICAL MEANS.

The subject may be divided into three classes: (1) the mechanical handling of freight at freight houses; (2) the mechanical handling of freight in general, at warehouses, piers, etc.; (3) the mechanical handling of railway baggage, mail and express matter.

Mechanical Handling of Freight at Freight Houses.

The difficulty in the application of mechanical conveying devices to the handling of freight in freight houses is not in devising such appliances, but in adapting them to conditions of handling (1) where the sizes and weights of packages are of infinite variety, and (2) where there are numerous points for receiving and delivering the packages. This problem has not yet been solved, and the nearest approach to its solution so far appears to be the introduction of small motor trucks as a substitute for hand trucks, thus retaining the flexibility and independence of the trucking system, while increasing the capacity and speed of movement.

The committee had but little specific information to report. In its report for 1913 it described in detail the telfer system as used for the double-deck freight station of the Missouri, Kansas & Texas at St. Louis, but the use of the system has now been abandoned. In reply to an inquiry as to the reason

C. H. SPENCER,
Chairman Committee on Yards and Terminals.

for this action, S. B. Fisher (now chairman of the Valuation Committee of that railway) wrote as follows:

"Our company has abandoned the method of handling freight by telfers, as our freight was of such a miscellaneous character and with such unhandy packages that we could not handle it economically with this system. I think, however, the principal difficulty is that our men were not educated enough for the handling of this freight, and that we were too far in advance of the times. It is with the outbound freight that we had the principal difficulty. We found a great deal of breakage, and freight shipped to wrong destinations under this system."

A brief description of the method of handling freight at the plant of the Texas City Transportation Company, Texas City, Tex., was included in the report. This plant was described in the *Railway Age Gazette* of July 12, 1912.

Improvements in Hand Trucking at Freight Houses.

In many cases it may be practical materially to improve the hand trucking system at freight houses, and two instances of such improvement may be mentioned.

The Illinois Central has used at its Chicago local freight house a method of handling L. C. L. freight which is known as the multiple truck system. There are 5 to 15 trucks to each trucker, and when a man brings his truck he does not wait for it to be loaded or unloaded as is ordinarily done, but takes another truck and handles another load. This eliminates much of the empty truck movement and the enforced idleness of the truckers, which prevails under the

ordinary system. It reduces the cost of floor movement about 30 per cent. Fifty per cent. of the saving is being distributed among the freight handlers in the form of increased pay. In describing this system at a meeting of the Traffic Club of Chicago, J. F. Barron, at that time local freight agent, suggested that in the absence of mechanical carriers or moving platforms in the city terminals the efficiency of freight handling could be greatly increased by the establishment of large outer sorting platforms or warehouses where outbound package freight could be assembled and consolidated, and where the floor movement could be performed by mechanical devices.

In replacing the telferage system with hand trucking at the St. Louis freight station of the Missouri, Kansas & Texas, mentioned above, steps were taken to reduce the time lost by truckage. The station being double-decked with the team platforms above and the car platforms below, trucks have to be handled by elevators. Two separate groups of truckers, one for each floor, are used. For outbound freight a trucker on the upper floor takes a loaded truck and runs it into the designated elevator, taking off an empty truck and going back for another load. A trucker on the lower floor takes the loaded truck and wheels it to the car, where he leaves it and takes an empty truck back to the elevator.

Conveyors at Piers and Docks.

Motor trucks and different kinds of conveyors are used for handling freight and cargo at steamship piers, but mainly in connection with coastwise shipping. Some conveyors handle the packages of freight, others handle the trucks. A portable cargo-handling conveyor consists of a conveyor belt on a truss frame which is hinged to a steel tower traveling on a track along the edge of the pier or quay. A motor drives the conveyor and propels the tower. The end of the truss is supported by cables which pass over the top of the tower and down to winding drums, so that the inclination of the conveyor can be varied to meet the level of the deck of the ship or barge.

The Merchants' and Miners' Transportation Company is using a portable gravity conveyor system at its steamship pier at Boston. The conveyor consists of ball-bearing rollers carried in side frames which are mounted on legs, giving an average grade of four per cent. The sections are about six feet long and their frames hook together. As used on the pier, a main run of the conveyor extends from the storage side of the shed to the water side, and branches with connecting curves are laid down the gangways and across the ship's deck to the hatches. Four hatches can be served at once.

The company states that this carrier has been found economical where used for one kind of freight and where the grade is uniform, but at Boston there is a tidal range of 9 to 12 ft., and the character of freight is miscellaneous, consisting of sacks, boxes, bales, barrels, etc.

It has been in use about a year with fair results. The greatest length of travel is 150 ft. and the speed of movement about 300 ft. per minute, while the heaviest packages handled average 400 lb. It is considered that it would be superior to hand trucking if the packages were uniform and would then reduce the number of men by some 20 per cent. Its disadvantages are in handling the variety of packages and in the congestion at the ship's ports.

The Boston & Maine handles freight mechanically at pier 45, Boston, Mass., where there is a Reno escalator which consists of a wooden frame 46 ft. long and 12 ft. wide, extreme grade 21 deg. with two Reno chain escalators, driven by separate 10-h.p. motors, which are reversible so that the chain can go in either direction. The chain engages the axles of two-wheeled trucks, pulling up and letting down load. The chains have two speeds, 150 ft. per minute maximum, with four to six trucks on each. The capacity is five tons concentrated load. The frame is adjusted to suit the tide with a hand hoist.

The Delaware, Lackawanna & Western has a new pier 500 ft. by 80 ft., at Hoboken, N. J., where eastbound freight is unloaded from cars and loaded onto barges for transfer to steamship piers. It has a double-deck steel frame superstructure with concrete walls, floors and roof. For handling freight between the main and upper floors, there are three 5-ton hydraulic platform elevators 9 ft. by 10 ft. and five electrically operated barrel and sack elevators with arms holding the packages. For descending freight there are also gravity chutes for packages and for barrels, movable sections carrying the freight from the bottom of the fixed chute to the desired points on the floor.

Day and Date	No. Machines Used	Hours in Use	Mileage	Commodity	Tonnage	Aver. Length of Haul, in Feet	Weight per Load in Pounds	Hours Loading and Unloading	Hours Running	No. Operators Required Elec. Truck	Cost of Labor Operating Elec. Truck	Cost of Current	Cost of Repairs—Elec. Truck	Interest and Depreciation	Total Cost—Elec. Trucks	Aver. Cost per Ton	Estimated No. Men to Run Hand Trucks	Cost Men Operating Hand Trucks	Cost of Repairs—Hand Trucks	Interest Depreciation	Total Cost Operating Hand Trucks	Average Cost per Ton Hand Trucks
1913																						
January...	3	265	220 5	Various	4196	529	2880	159 89	60.67	11	557.46	33.00	15.80	42.51	648.77	.1546	14	709.12	9.93	1.81	720.86	.1717
February.	3	248¾	203 7	Various	5743	589	3799	182.18	66.57	18	892.54	27.71	50.20	45.03	1015.48	.1768	18	1136.00	7.97	1.45	1145.42	.1994
March....	3	158½	183	Various	2336	840	2135	100.65	57.85	11	321.98	22.75	43.10	24.26	412.09	.1764	14	423.60	6.63	1.20	431.43	.1846
April.....	4	161¼	287 4	Various	3751	861	1980	97.06	61.69	11	333.27	32.91	38.70	43.45	448.69	.1196	13	494.73	9.17	1.66	505.56	.1347
May.....	3	123¾	188.3	Various	2509	697	2476	67.34	56.41	12	323.80	43.32	65.81	30.64	463.57	.1847	15	453.53	7.01	1.27	461.81	.1840
June.....	3	135	177.2	Various	3418	555	2641	184.86	50.14	12	322.93	37.87	22.12	29.37	412.29	.1206	18	609.02	9.41	1.50	619.93	.1813
Total...	.....	1092¼	1260.1	.....	21953	.....	.....	.....	.....	.....	.....	.....	.....	.....	3400.90	.....	.....	.....	.....	.....	3885.01	.....

Total Cost per Ton—
Electric Truck.....$ .1549
Hand Truck..... .1770
Decrease..... .0221

Comparison of Operation Costs of Electric and Hand Trucks at New Orleans.

The New York Dock Company has piers and warehouses at Brooklyn, N. Y., and uses both motor trucks and conveyors for handling miscellaneous freight between the warehouses and the bulkhead line, but these facilities extend along the piers. A six-story warehouse is served by a telfer system which extends through the second floor and over a bridge to a railway freight house. From the front of the warehouse, the runway extends along a bridge which crosses the deck front by a 76-ft. span, the other end of the bridge being carried by a tower on the bulkhead wall. A hinged apron 30 ft. long can be lowered so as to extend the runway over the deck of a barge or lighter. The runway is a 15-in. I-beam and carries electric hoisting trolleys of 5,000 lb. capacity. These trolleys handle special freight trucks having platforms 3½ ft. by 8½ ft., mounted on two casters at one end and two 10-in. ball-bearing wheels at the other end.

The Canadian Pacific has a freight pier at Fort William, Ont., which is used largely for shipping flour, and is equipped with electrically-operated belt conveyors for handling the sacks. Along the rear or track side, and just beneath the upper floor is a 26-in. conveyor belt extending the full length of the building, while five transverse belts at a slightly lower level extend across the building to fixed chutes. Portable chutes attached to these carry the sacks to the hatches of the vessel. Over the main belt, at each of the transverse belts, is a diverting device which consists of a board placed at 45 deg. across the belt, so that when lowered it throws the sacks off upon the transverse belt. By the operation of

these boards, the sacks can be sorted while moving, so as to deliver a certain brand at each hatch if desired.

Types of Conveyors for Freight Handling.

Telferage: This system of handling goods by motor trolley hoists running on overhead runways is being used extensively. An electrically operated telfer system has been installed at the Hood Rubber Company plant, East Watertown, Mass., for handling loads of 250 to 5,000 lbs. It serves five buildings and crosses a railway line, which separates a group of buildings, and in this way it eliminates a former detour to a grade crossing. The runway is a single 12-in. I-beam, carried on brackets along the outside of the walls of the buildings and by steel bridges between the buildings. On this runs the motor trolley with a 2½-ton hoist. There are grades of 2½ and 4 per cent. on the line. It is stated that two years' service with one trolley, which was not sufficient to entirely eliminate handling by teams and trucks around the plant, reduced the operating cost of handling the material around the plant by 67 per cent., as compared with the former exclusive use of teams and trucks.

NAME OF RAILWAY	LOCATION OF HUMP YARD	No. of Yards in Use
Baltimore & Ohio	Brunswick, Chicago Jct., Chicago, Cumberland, Connellsville, Fairmont, Holloway, Keyser, New Castle Jct	9
Belt Railway of Chicago	Chicago Clearing Yard	1
Boston & Maine	Worcester, Mechanicsville	2
Canadian Pacific	Winnipeg	1
Central of New Jersey	Allentown, Mauch Chunk (Gravity one way)	2
Chesapeake & Ohio	Russell, Ky., Silver Grove, Ky	2
Chicago & Eastern Illinois	Dalton, Salem	2
Chicago, Burlington & Quincy	Hawthorne, Galesburg, Lincoln, Neb	3
Chicago, Indiana & Southern	Gibson, Ind	1
Chicago, Milwaukee & St. Paul	Air Line Milwaukee, Godfrey	2
Cleveland, Cincinnati, Chicago & St. Louis	Harrisburg, Lyons	2
Delaware & Hudson	Oneonta, N. Y	1
Illinois Central	Centralia, Ill., Harahan	2
Kentucky & Indiana Terminal	Louisville, Ky	1
Lake Shore & Michigan Southern	Collingwood, Elkhart, Ind	2
Louisville & Nashville	Radnor, near Nashville	1
Michigan Central	Windsor, River Rouge, North Detroit, West Detroit	4
Minnesota Transfer	Minnesota Transfer, Minn	1
Missouri Pacific	Dupo, Ill., Kansas City	2
Nashville, Chattanooga & St. Louis R'y	Atlanta, Nashville	2
New York Central	Avis, Dewitt, Gardenville, West Albany	4
Norfolk & Western	Bluefield	1
Peoria & Pekin Union	East Peoria	1
Pennsylvania Railroad	Altoona, Edgemoor, Enola, Ebenezer, Harrisburg, Hollidayburg, Honey Pot, Maryville, Pitcairn, Waverly, West Philadelphia, Youngwood, Northumberland	13
Pennsylvania Lines West (Southwest System)	Scully, Pa., Bradford, Ohio, Columbus, Ohio, Grand View, Ohio, Fulton, Under Cliff (both at Cincinnati, Ohio), Richmond, Ind., Logansport, Ind., 59th Street, Chicago	9
—Northwest System	Allegheny, Conway, Mansfield, Crestline, Chicago, Bedford, Cleveland, Wellsville, Shop	9
—Central System	Cambridge, Y. D. Yard, Lancaster	3
Philadelphia & Reading	Rutherford	1
Pittsburgh & Lake Erie	Glassport, Pa., Haselton, Ohio, McKees Rocks, Pa., Newell, Pa., Dickerson Run, Lynch	6
Southern	Asheville, N. C., Inman, Ga	2
Terminal of St. Louis	East St. Louis	1
Union	Oak Hill, Pa	1
Washington Southern Railway	Alexandria, Va	1
Total		95

Hump Yards in Service and Under Construction in the U. S. and Canada, from Information Collected by the Committee.

The four-story warehouse of the wholesale grocery firm of M. A. Newmark & Company at Los Angeles, Cal., handling some 200 tons daily, has a telfer system on each floor, with two spiral chutes and four elevators. Packages in the cars are loaded into small trucks, which are then pushed out on the platform to be picked up by the telfer carriers. Loads are carried from cars to the storage in less than two-thirds the time, and with less men than required by the former system.

Belt and Platform Conveyors: These are of numerous designs adapted to various purposes, and are used very extensively for both horiozntal and inclined movements, for short and long distances. In some cases they extend across bridges from a warehouse to a pier or dock front, and by a hinged extension at the end the package can be delivered or loaded at the ship's hatch. One form of portable cargo conveyor has its belt frame carried on a truss attached to a tower or frame which travels along the dock wall. The attachment is hinged and the outer end of the bridge supported by cables from the tower, so that the inclination can be varied to suit the level of the ship or barge. Belt conveyors have been applied to the handling of mail sacks, light baggage and express matter at postoffices and railway stations, and for handling baggage at steamship piers.

Gravity Conveyors: These consist of rollers carried in side frame; mounted on legs, and for portable use the conveyor is made in sections straight or curved about six or eight feet long. The Matthews conveyor uses ball-bearing steel rollers, and gives a grade of about 4 per cent. It will handle loads of 5 to 300 lb. For portable use, the legs of each section may be fitted with casters. These can be used only for a down-grade movement, but for long runs in factories, warehouses and industrial plants an automatic motor-driven inclined or vertical elevator raises the packages to the top of the gravity run. Spiral conveyors are made in the same way, and where packages of various kinds are used they have the advantage that all packages move at approximately the same speed, while in spiral sliding chutes the speed varies with the weight and a heavy package may overtake and crush or damage a lighter package. These conveyors are used extensively in industrial work, and several railways are using short runs of them for special purposes, such as handling shingles, brick, etc.

Gravity Chutes: Straight and spiral inclined chutes are used extensively in stores, warehouses, etc., also at some railway stations for lowering mail sacks and light baggage from upper to lower floors. Open chutes or troughs are used for the larger and heavier class of packages, but for lighter packages the chute is a steel spiral inclosed in a steel cylinder, with loading doors or discharging chutes at the different floors. The openings are equipped with automatic fire doors.

Truck Conveyors: To facilitate the movement of hand trucks on inclines, there are different makes of traveling chains and platforms, the chains having arms or lugs to engage the trucks. These are used in pier sheds, warehouses, etc., but more extensively at steamship piers, on the inclined gangways from the floor to the level of the ship's lower-deck side ports. The trucker keeps hold of his truck in the usual way, and in some cases the chain forms part of an endless traveling platform on which the men stand, but usually the men walk beside the chain. This method is a great saving of time and labor, especially where the incline is steep, as in reaching the deck level at low tide. A modified application of this is a traveling chain laid along the floor of a pier or warehouse, forming two straight runs with loop ends. Trucks may be wheeled to the conveyor at any point. Empty trucks can be returned on the side of the run.

Motor Trucks: The use of motor trucks of about 1-ton capacity for handling freight and baggage is on the increase, and such trucks seem to be the most practicable method so far devised to increase the facility and economy of ordinary freight-house work. A special form of motor truck has been introduced, equipped with an electrically operated crane capable of handling loads up to one ton. This could load cotton bales, etc., upon its own platform, carry the bales to a wagon, and load them on the wagon; it can also handle such loads to and from other trucks.

The Illinois Central has in use for Elwell-Parker electric trucks at Stuyvesant docks, New Orleans.

Each of these trucks frequently handles one or two trailers. These trucks are also used in rehandling tobacco from warehouse to wharf, in which event the trucks keep six men busy loading, two unloading and one operator for each truck. In transporting cotton the trucks keep four men busy unloading, one operator for each truck. The performance of these trucks for six months ending June 30, 1913, as compared with former hand trucks is shown in the accompanying table.

Mechanical Handling on English Railways.

An inquiry as to the use of appliances for the mechanical handling of freight on English railways indicates that with few exceptions the only appliances of this kind are elevators and cranes at freight and passenger stations. At docks and quays cranes are employed to handle baggage to and from steamers. At coal shipping ports, special hoists and electric and hydraulic cranes are used; also car-dumping machines for the small cars used on English railways. A class of freight-house crane used in England is an overhead traveling crane, with a revolving trolley hoist fitted with a horizontal boom.

On the Lancashire & Yorkshire the large freight stations and yards are well equipped with various appliances. In Lancashire, heavy cotton traffic, which is carried in flat cars of 8 to 10 tons capacity, is handled by means of steam and electric overhead traveling cranes. A variation of this is the use of steam or electrically-driven gantry cranes. Light goods are handled usually by electric, hydraulic or manual

cranes of 3,300 lb. capacity fixed on a stage or platform. The company has been going in very largely for sheds fitted with fast overhead electrically-driven cranes of 1,680 to 3,360 lb. capacity. The bridge is composed of a pair of parallel boom horizontal trusses, with the hoisting trolley traveling on the lower booms. These are very suitable for bales of cotton and light machinery and also paper and special traffic, as by this means a large volume of traffic can be handled at a very low rate per ton.

Special cranes include an electric cantilever gantry crane of 10 tons capacity, with truss 180 ft. long on a central tower for handling timber at North Mersey, Liverpool; also electric walking cranes in a wool warehouse at the Bradford freight yard. This wool warehouse is the largest and most completely equipped in England. The mast of the crane is mountd on a frame with wheels traveling on a single rail in the floor while the head rides in guides on the girders; it carries a revolving boom.

Freight and Cargo Handling Appliances at Foreign Ports.

American seaports are much less completely equipped with freight and cargo handling appliances than are the large European ports.

At the Princes Landing Stage at Liverpool, where the transatlantic steamers embark and disembark passengers, mechanical conveyors are used for the transfer of baggage to ships and cars. One of the bridges connecting the landing stage with the shore has a traveling platform in two parts, running in opposite direction. This is used for carrying the baggage trucks, the loaded trucks moving in one direction and empty trucks in the opposite direction.

For handling cargo the various docks have an extensive equipment of cranes. From a pamphlet published by the Mersey Docks and Harbor Board it appears that there are about 130 hydraulic traveling cranes of 1½-ton capacity, mounted on the roofs of the sheds, 20 similar electric cranes, 40 hydraulic wall cranes of 1-ton capacity and numerous steam and hydraulic cranes of 3 to 100 tons capacity. The roof cranes avoid interference with the space on the dock front. There are also about 25 hydraulic coaling hoists, handling cars of 20 and 15 tons capacity (total weight 30 and 32 tons), and shipping coal at the rate of 300 tons per hour. Most of these travel along the dock wall. There is also a coaling dock capable of shipping 2,300 tons per hour. The new Gladstone Dock has 1½-ton semi-portal electric cranes and a 5-ton steam locomotive crane.

At London a stevedoring firm, Scrutton's, Limited, has installed three conveyors worked by electricity: first, for carrying jute and other fibers in bales from a shed used for the storage of general goods into a shed set apart for the storage of fibers, a distance of 180 ft.; second, for discharging tea from a ship and conveying it into the warehouse. The sorting to marks is done by pushing the packages off at given points where men are stationed; third, for discharging frozen meat and conveying it along the quay.

The delivery to barges or railway trucks for different destinations is accomplished by lifting the meat off the conveyor when the particular mark required reaches the point where the barge or railway truck is placed.

The crane equipment of the Manchester docks includes 53 hydraulic, 64 steam and 109 electric cranes, varying in radius from 16 to 40 ft., with a lifting capacity of from 1 to 10 tons, to a height from rail level of from 13 ft. to 50 ft. There is also a 30-ton steam crane and a pontoon sheers capable of dealing with weights up to 250 tons with a lift of 21 ft.

An appliance which has proved of great utility in connection with the cargo handling cranes is the hatchway control gear. The crane operator is provided with a small controller which is slung from his shoulders and weighs about 7 lbs. By means of two handles fitted on either side, the lifting, lowering and slowing movements are under complete control. Attached to the switch is a flexible armored cable which passes to the crane ring posts and to the set of small collector rings, the motors being operated through a system of contactors.

By means of this appliance, the discharge and loading of vessels can be performed with greater rapidity and with more safety than by means of the old system. Instead of the crane man being located 30 to 60 ft. from the hold, he is able to stand beside the hatchway, carrying the small control apparatus, and to move with perfect freedom. He can without difficulty sight the load from the bottom of the hold until it is deposited upon the quay shed, railway wagon or barge.

At the Partington coal basin on the canal there are six hydraulic car-dumping machines for loading coal direct from railway cars into ocean steamers. Each tipple has a capacity of 300 tons per hour. The coal is brought in cars on the lower level lines, raised by hydraulic power to the higher level, and then tipped, the empty car being returned by gravity to the railway sidings.

At the Manchester docks, a 25-ton hydraulic crane has recently been erected for coaling vessels in the docks. This crane is of the center pillar or pivot type and is fixed on a concrete foundation. It is capable of performing the following operations: First, lift and readily handle a load of 25 tons at a radius of 35 ft.; second, lift the load to a height of 25 ft. from the level of the railway on the wharf immediately behind the crane foundation to the lowest part of the inside of the cradle in any position; third, slew 450 degrees in either direction; fourth, raise a cradle carrying a standard 12-ton coal car from a horizontal position to an angle sufficient to discharge the coal quickly out of the wagon.

The crane is provided with a luffing jib capable of being raised and lowered under loaded or any conditions so as to vary the working radius of the crane to the extent of 12 ft. The operations of lifting, slewing, luffing and tipping can be carried out at the same time. All the motions of the crane are actuated by hydraulic pressure which is available from the company's mains at 700 lbs. pressure.

DESIGN AND OPERATION OF HUMP YARDS.

The large hump yard recently completed by the Canadian Pacific at Winnipeg, Man., was briefly described and illustrated in the report. A full description of this yard was published in the RAILWAY AGE GAZETTE of April 18, 1913.

Circular letters asking for information relative to operation and construction of hump yards were sent out to all roads operating yards of this type, the following information being requested:

(1) Cost per car for yard operation.

(2) Cost per car in old flat yard before hump yard was built, or cost in other flat yards as nearly comparable as possible, so that economies of the hump yard may be noted.

(3) The maximum number of cars put over the hump in any one hour, and the estimated capacity of the hump yard in 24 hours.

(4) Do you recommend any changes in grades on the hump as shown in the Manual?

(5) Is track scale located on hump? If not, where?

(6) How many cars should be handled daily to warrant the use of a hump yard?

(7) How do you determine the number of car riders required to handle cars on the hump; that is, have you any definite rule to determine the number of riders required to handle a certain number of cars?

(8) How do you employ car riders so as to secure the necessary elasticity when force is to be decreased or increased?

(9) What system are you using in hump coal yards to indicate to towermen or the men throwing switches what track the cars are to be placed on?

(10) Advise if this system is a success, and if not, what modification can you suggest?

(11) Do you consider departure yards desirable?

(12) Advise if you are using them.

(13) Please send print of plan and profile of each hump yard covered in the above report.

Reports were received from 15 leading roads, giving data covering 29 hump yards, which is recapitulated as follows:

Question (1) 28 yards report an average cost in hump yard of 21.2 cents per car.

Question (2) 11 flat yards report an average cost of 22.91 cents per car.

Question (3) 22 hump yards report an average of 72 cars over the hump per hour.

Twenty-four hump yards report their average capacity per 24 hours at 1,973 cars.

Question (4) Of the 15 railroads reporting, 9 make no recommendations in regard to changing grade on hump; 1 submits plans of grades recommended, and 1 found it necessary to make changes in grades recommended in the Manual.

Question (5) Of the 15 roads reporting, 9 have scales on hump and 6 have no scales on hump. Of the 29 yards reported, 19 have scales on hump, 8 have scales in yard and 2 have no scales, either on hump or in yard.

Question (6) An average of the reports from 24 yards indicates that at least 800 cars must be handled daily to warrant the use of a hump yard.

Question (7) 24 yards regulate the number of car riders, according to business in sight; 4 have no definite rule and 1 figures on the basis of 7 cars per rider per hour.

Question (8) 23 yards maintain an extra list of car riders and draw on it as required; 4 yards maintain an extra list of switch tenders and use switch tenders for car riders as required.

Questions (9) and (10) 20 of the yards covered in this

report use switch list to indicate cars cut off on the hump; 8 chalk track numbers on the ends of cars, and 1 uses telephone. All report the system they are using as successful.

Questions (11) and (12) Reports from 14 railroads covering 29 hump yards show that 16 yards have departure yards, and 13 have no departure yards. Reports from 28 of the yards favor the use of departure yards.

TRACK SCALES.

The committee received copies of the amended specifications issued by the American Railway Association, and is giving these careful consideration, together with such other data as they have been able to obtain during the past year. It was recommended that the subject of track scales be continued for next year's report.

C. H. Spencer (Washington Term.), chairman; E. B. Temple (P. R. R.), vice-chairman; W. G. Arn (I. C.), H. Baldwin (C. C. C. & St. L.), G. H. Burgess (D. & H.), A. E. Clift (I. C.), H. T. Douglas, Jr. (C. & A.), A. C. Everham (K C. T.), R. Ferriday (C. C. C. & St. L.), G. H. Herrold, G. P. Johnson (C. & O.), D. B. Johnston (P. L. W.), H. A. Lane (B. & O.), L. J. McIntyre (N. P.), B. H. Mann (M. P.), A. Montzheimer (E. J. & E.), H. J. Pfeifer (T. R. R. A. of St. Louis), S. S. Roberts (Consulting Eng.), W. L. Seddon (S. A. L.), E. E. R. Tratman (Eng. News), E. P. Weatherly (K. C. T.), W. L. Webb (C. M. & St. P.), C. C. Wentworth (H. & W.), J. G. Wishart (C. R. I. & P), Committee.

Discussion on Yards and Terminals.

The report was presented by E. B. Temple, vice-chairman.

B. H. Mann: The thought on the analysis of the capacity of passenger stations is that something should be devised somewhat along the lines of the same analysis of the line. The terminal situation is generally worked up by, you might say, the rule of thumb. The committee feels there is no reason, after a study of two or three or four or five years, why some sort of a method cannot be applied to a congested passenger terminal, and this year's study has been along the same line of following up what was done last year.

E. H. Lee (C. & W. I.): In regard to handling freight by mechanical means, it occurs to me that other matters which are not so fundamental, and which do not involve anything like the same expenditure of money or the necessities of operating a railroad, have received a great deal more attention in the past than this particular subject. While congestion has been constantly increasing and has been going on under the old methods a great many years, in very few places have the limits of the present methods been reached. The investigations which we had made led us to believe that a good many of the claims made for mechanical handling of freight cannot be substantiated. Other claims for certain devices can be backed up by experience; certain devices are exceedingly valuable in a detail way, but I question as to whether in the strictly mechanical handling of l. c. l. freight any method can be devised which will make good the claims made for it without greatly increasing the capacity and without greatly increasing the cost. One particular phase of the subject that has impressed me radically is the fact that in using mechanical means for handling l. c. l. freight, the mechanism offered has directly introduced an element of extra handling. Anybody who knows anything about handling freight in any important city terminal knows that the mere process of transporting that freight from one point to another is by far the easy part of the game. I wish to be understood as not objecting to any particular method of handling, and I must be understood as saying that for certain purposes mechanical handling of all kinds is well devised and even economical, but it seems to me that mechanical handling must be used with caution. It must be adjusted to the needs.

F. L. Stuart (B. & O.): There are very few cases in which we found mechanical handling to be an advantage. There is one suggestion I would like to make to the committee. The plans for the yard are quite complete, but we must go further than that. We want plans for organization. I think the committee can outline an organization that will be efficient and practical under all circumstances. There is another thing that occurs to me. I think we use our yards too much. I think we ought to have more work done on the main line, or on one or two side tracks, with a short lateral track leading off of it to set off on your pick-up.

W. B. Scott (Sunset Central Lines of So. Pac.): The point brought out by Mr. Lee seems to be a very pertinent one. We have found that the reloading of trucks practically eats up the saving in expense of the mechanical operation.

Mr. Montzheimer: The committee on Design and Operation of Hump Yards considered the question of new construction of hump yards and picked out the Canadian Pacific yard, at Winnipeg, as a typical hump yard of recent construction. You will note in the report that we have gone into the question of cost per car handling in hump yards, compared with the cost of handling the car in the ordinary flat yard. The information is not altogether satisfactory, because we find in ordinary hump yards more work is being done in the way of classifying cars than was done in the old flat yards.

W. I. Trench (B. & O.): I would like to ask if in the design of the hump on scales consideration was given to selecting grades so that there would be a sufficient separation of cars at the switch of the dead rails, so that the switch could be operated either by hand or by interlocking without withdrawing the cars coming up the grade? On our line the signal people are very insistent that the non-weighers use the dead rails. In the way the hump is designed, there is not only loss of time in withdrawing the column of cars down the approach grade, but there is wear and tear on the equipment, which would seem unnecessary, and there is loss of steam. I believe it is possible to design a hump which will give the separation and possibly slow down the car and the scales to the required limit. I think that should be gone into.

Mr. Lindsay: We have been studying our yard at West Albany very accurately, and have endeavored to increase its capacity, first, by the use of some means of returning the riders to the hump, which we found one of the greatest sources of delay. We also found it necessary to take into consideration the prevailing wind, the temperature, and the operating conditions as the trains coming into the receiving yard, as to how long they stood before they were humped—all of these things will be, I believe, of value in the further study of this subject. The question of poling yards has also become vital with us, where hump yards are not possible. We have also found we can increase the capacity by the introduction of the poling system 25 per cent, without increased cost.

J. L. Downs (I. C.): In connection with the work on Yards and Terminals, Design of Hump Yards, etc., I believe attention should be paid to the movement of cars. Yards, as we know, retard the movement of cars. Good transportation experts will see that the proper cars are put in train at a certain terminal to run to various other terminals without switching. It is a part of the work of this Association to so design our yards and terminal facilities, such as coaling and water stations, in such a way as to incrase the movement of cars. If the railroads of the United States could increase the mileage of their cars five miles a day, it would be millions of dollars in revenue to the railroads. I think it is the work of this committee to so design the yards as to figure the movement of a car continuously through the terminals without delay.

ROADWAY

UNIT PRESSURES ALLOWABLE ON ROADBED OF DIFFERENT MATERIALS.

To be able to make any definite recommendations as to allowable unit pressures on roadbed the following points or facts must be determined:

(a) The distribution of the wheel load and impact among the several ties and its variations due to different weights of rail, tie lengths and spacing.

(b) The distribution and variation of this load throughout the ballast from the bottom of the tie to the subgrade for various kinds and depths of ballast.

(c) The ability of subgrade soils of various physical characteristics to withstand the load imposed by the ballast.

(d) A classification of subgrade soils or such minute and detailed description of each kind that they may be readily identified.

(e) A determination, experimentally, of the mechanics of the problem of supporting a load on a soil plane, such as the ballast on the subgrade or an embankment on a level plane.

The objects to be obtained by determining the allowable unit pressures on roadbed are:

(a) A more rational design of track superstructure based upon a definite knowledge of the value and distribution of the forces involved, such, for instance, as determining the proper length and section of metal ties to replace the present standard-length ties at points where the area of subgrade covered by the ballast is insufficient to support the present or a proposed increase in weight of rolling stock.

(b) The detection and possible elimination of unnecessary and indeterminate stresses in the rail due to variations in the supporting power of the subgrade soil.

(c) The reduction of maintenance charges by a better understanding of the causes of irregular depression of the track superstructure under traffic.

(d) In new locations the engineer knowing the bearing

power of the soils encountered may compare a longer line with low maintenance with a shorter line over soils of less bearing power and consequent higher maintenance charges.

The principal benefits to be derived are an increase in safety of operation and a decrease in cost of maintenance.

Sufficient preliminary discussion has been had to determine that nothing further can be done toward defining allowable unit pressures on roadbed till experiments under actual traffic conditions have been made.

A special committee has been appointed and arrangements made for a fund sufficient to start the experimental work. In case these funds should prove insufficient due to an enlargement of the scope of the investigation, it is the sense of this committee that a prorata assessment on a mileage basis be made against the railways represented in this Association. At the rate of four-tenths of one cent ($0.004) per mile for each $1,000 additional required, this levy would amount to only $70 for the largest system represented.

TUNNEL CONSTRUCTION AND VENTILATION.

The committee reports as the result of its investigation on tunnel construction:

(1) That the railway tunnels, as ordinarily constructed in the United States, are more economically built by driving first the heading entirely through, but that such method usually requires a greater length of time for completion of the tunnel.

W. M. DAWLEY,
Chairman Committee on Roadway.

(2) That for material requiring support, the top heading should be usually driven.

(3) That it is economical and expedient to use an electric shovel or an air shovel for the removal of the bench where the section of the tunnel permits the safe operation of the same; and that where the material does not require support, there are advantages in low cost and quick removal of the bench in driving the heading at the subgrade line.

(4) That where the time limit is of value, the heading and bench should be excavated at the same time, the heading being kept 50 ft. in advance of the bench. Where the material of roof is not self-supporting and timbering is to be resorted to the bench should not be removed until the wall plates are laid and the arch ribs or centering safely put up.

(5) That opposing grades should never meet between the portals of a tunnel, so as to put a summit in the tunnel, and where practicable, the alinement and ascending grades in the tunnel should be in the same direction as the prevailing winds.

(6) That the accompanying drawings, Figs. 1, 2 and 3, are representative of American practice in single-track tunnel construction, where the time limit is of value.

A heading in material of the kind shown on Fig. 1 is usually driven by a "V" cut, using from 16 to 22 holes about 8 ft. deep. The holes near the middle of the heading are drilled so as to nearly meet at the end. These holes are the first one shot, then the second row and outside holes last. The arrangement of these holes will vary slightly, according to the way the material breaks. The bench in hard material of this kind is usually taken out in two lifts of almost equal weight. A sub-bench is drilled from 20 ft. to 40 ft. in advance of the bench. From 4 to 8 holes in a row, with about 6 to 8 ft. face, are used in both the sub-bench and the bench. One or two rows of holes may be used. Center holes are shot first, round and side holes last.

A heading in material of the kind shown in Fig. 2 is usually driven by a "hammer cut," using from 14 to 20 holes 6 to 10 ft. deep. The bottom row of holes is inclined at about an

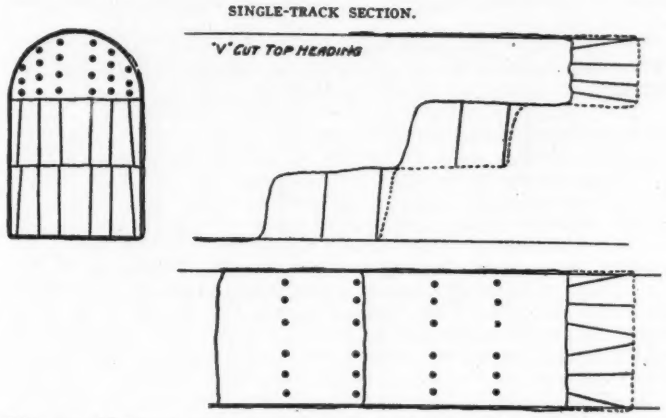


Fig. 1. Method of Tunnel Construction in Hard Rock with Few Seams.

angle of 30 deg. The bottom row is shot first and each row shown in succession. These holes should be arranged to suit the seams in the material. A bench in material of this kind is usually taken out in two lifts, but the sub-bench is not as deep as the bench. The sub-bench is best drilled from 20 ft. to 40 ft. in advance of the bench. From 4 to 6 holes in a row may be used with from 6 to 10 ft. face. The bench is sometimes taken out in one lift. Center holes are shot first, round and side holes later.

The method shown in Fig. 3 is only used when the material is so soft that a heading cannot be driven for the full length of timber used for the wall plate. Drifts about 4 ft. wide and 6 ft. high are driven for each wall plate, and then the core is taken out as timber rings are put in. Three or four holes may be used from 3 to 5 ft. deep in each drift. The amount of shooting necessary depends entirely upon the softness of the material. It can often be picked. The core may be soft enough to pick, or may be shot with from 4 to 8 holes, either drilled from face as shown or from sides of drifts. A bench in this class of material is shot in one or two lifts. Only very few holes are necessary.

As a result of its investigations, the committee is convinced that tunnels less than half a mile in length when constructed according to adopted section of the Association, and with

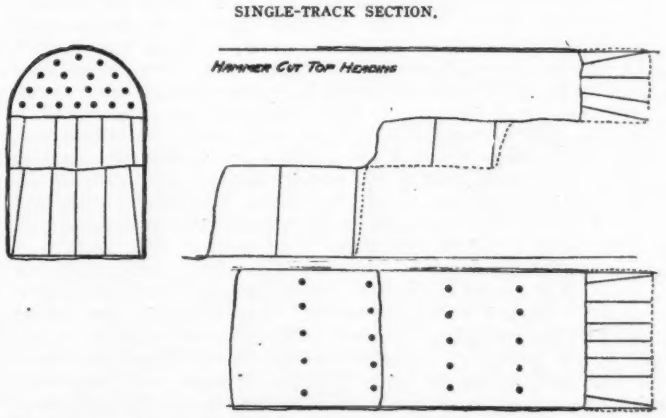


Fig. 2. Method of Tunnel Construction in Moderately Hard Rock with Seams.

traffic of less than 30 trains daily, do not usually require artificial ventilation. There are many tunnels in this country more than half a mile in length that carry successfully traffic in excess of 30 trains daily without the aid of artificial ventlaton, and while there is in general a direct relation in the need of ventilation to length of tunnel, amount of traffic and size of tunnel section, there are exceptions growing out of local atmospheric conditions and local operating conditions

that forbid the committee from undertaking to fix any definite length or size of section of tunnel as the limit for the installation for artificial ventilation. The committee is convinced that the most practicable, effective and economical artificial ventilation for tunnels carrying steam-power traffic is to be obtained by blowing a current of air into one end of the tunnel for the purpose of removing, or of diluting and removing, the smoke and combustion gases at the opposite end. As practiced in America, this way of procuring ventilation partakes of two methods:

(a) To blow the current of air in the direction the train is moving with sufficient velocity to remove the smoke and combustion gases ahead of the engine:

(b) To blow the current of air against the direction of the train with velocity sufficient to dilute the smoke and combustion gases to such an extent as not to be uncomfortable to the operating crews and to clear the tunnel entirely within the minimum time limit for following trains.

The Elkhorn Tunnel is 3,000 ft. long with a section of 235 sq. ft. The tunnel is for single track, with double track extending from each end of the tunnel. The tunnel is at the top of a long 2 per cent. grade opposed to the heavy coal movement to Norfolk. The grade through the tunnel is 1.4 per cent. The coal trains are handled over the 2 per cent. grade approaching the tunnel with three Mallet engines, one at the head and two in the rear. When the train enters the tunnel one of the rear engines is cut off, and the train is carried through the tunnel with one engine at the head and one at the rear. The air is blown into the tunnel from the lower end and in the direction the train is moving up-grade, the locomotives being loaded to their tonnage capacity. The velocity of the current is 1,700 ft. per minute, which is about double the speed of the train. The air current carries the smoke and combustion gases ahead of the engines, making the tunnel clear during the passage of the train. No blowing is done except when the trains are going up-grade through the tunnel.

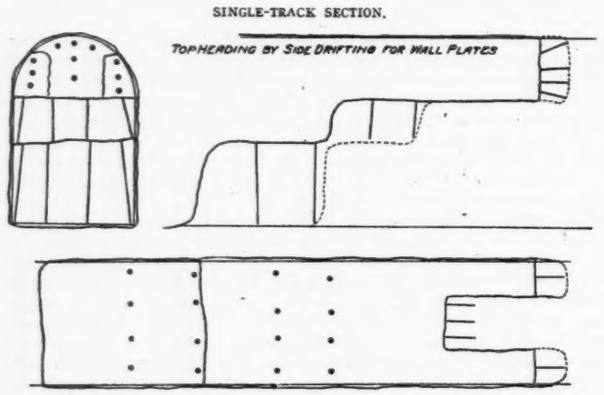


Fig. 3. Method of Tunnel Construction in Soft Rock or Hard Clay.

This method of blowing is most effective and economical in operation only for single-track tunnels of rather small section, where the locomotives are ordinarily worked to their tonnage capacity and consequently for trains running at speeds of ten miles per hour or less. This type has, therefore, a limited use, but it is the desirable type where the conditions are such as permit its installation.

The Big-Bend tunnel is 6,500 ft. long, with a section of 250 sq. ft. The grade is 0.4 per cent. against the heavy coal movement toward Newport News. This grade is the ruling grade for the operating division. The current of air is blown against the train, and the effect is merely to dilute the smoke and combustion gases by furnishing a supply of fresh air, which the current cools and also removes the smoke and gases quickly from about the engine cab. After the train has left the tunnel the blowing is continued until the tunnel is clear, which in practicable operation will be within the minimum time interval for following traius.

This method is adapted to tunnels of all sections and for all speeds of trains. The amount of dilution (and therefore the power necessary for its production) is in control of the engineering department. These advantages make the Big-Bend tunnel method the type for general use. Your attention is directed to the table attached, showing the points of installation of the type of tunnel ventilation recommended herein.

After considering the various types of tunnel ventilation, and from its investigations of the two typical tunnels as above set out, the committee is convinced that effective ventilation for American railway tunnels (exclusive of the type more properly designated as subways) can be obtained only by blowing a current of air into the tunnel during the passage of the trains of sufficient volume to dilute the smoke and combustion gases to such a degree during the passage of the train as to prevent the possibility of partial asphyxiation of the train crew and to cool the smoke and gases and remove them entirely from the tunel section within the minimum time limit for following trains. It regards the Elkhorn type as a special development to be used only where the conditions are favorable.

It is interesting to note that for the first method the small section is most economical, because of less volume of air to be moved, and that the installation of this method of ventilation will enable a railway company to defer enlargement of the tunnel sections of many of the tunnels built long aga, and even delay the necessity of constructing a second-track tunnel in locations where the existing single-track tunnel can be advantageously operated as a gauntlet in a double-track line.

ECONOMICS IN ROADWAY LABOR.

Ordinarily, construction work is assigned to contractor's forces and aside from separation of grades (track elevation, subways, etc.), it is seldom necessary to call on the railway engineer to organize labor forces for this class of work. In view of the fact that all such work is confined to congested terminals, where the magnitude of the work to be accomplished, the time allowed and the interference to traffic are so variable, the committee feels that any recommendations it might make would be of little or not value.

We do not desire to treat the subject "Economics of Railway Labor" lightly, believing as we do that it is the one important subject before the Association and its individual membership, from a maintenance standpoint. In fact, and with all due deference to the work which has already been done by several committees, we believe that the subject is on that should have the careful study of a special committee, which should be instructed to make its recommendations as to consolidations that might be made to accomplish greater efficiency in inspection and repairs. Some of our members have already recognized the practicability of combining the duties of inspection forces and others have assigned combined crews to miscellaneous repairs. It is believed there is a large field for economical work along these lines.

RECOMMENDATIONS FOR NEXT YEAR'S WORK.

(1) That subject No. 1 be kept under consideration till the special committee on Stresses in Track has made its report.

(2) Submit specifications for the protection of slopes by sodding or otherwise.

(3) Consider the subject of acquiring land for right-of-way from the original survey and option to the final purchase, monumenting and entering on right-of-way maps, submitting necessary forms.

(4) Harmonize specifications heretofore adopted with the Uniform General Contract forms adopted last year.

(5) The construction and maintenance of tracks in tunnels.

(6) The element of cost of earthwork in railway construction.

W. M. Dawley (Erie), Chairman; J. A. Spielmann (B. & O.), Vice-Chairman; M. J. Corrigan (B. & O.), J. R. W. Ambrose (G. T.), Ward Crosby (C. C. & O.), W. C. Curd (M. P.), Paul Didier (B. & O.), R. C. Falconer (Erie), S. B. Fisher (M. K. & T.), Frank Merritt (G. C. & S. F.), L. G. Morphy (B. & A.), W. D. Spence (Board of Valuation Engineers), F. M. Patterson (C. B. & Q.), L. M. Perkins (N. P.), W. H. Petersen (C. R. I. & P.), A. C. Prime (P. R. R.), H. J. Slifer (Consulting Engineer), J. E. Willoughby (A. C. L.), W. P. Wiltsee (N. & W.), Committee.

Discussion on Roadway.

The report was presented by W. M. Dawley, the chairman of the committee.

W. M. Dawley: A subcommittee has been appointed to determine the distribution of reel loads and impact on the ties, and how it is influenced by the different weights of rail, to consider tie lengths, tie spacing, distribution and variation of the load throughout the ballast, to determine what is necessary for a proper depth of ballast and also the different classes of soil to support the various loads. The principal benefit to be derived will be an increase of safety first, followed by a decreased cost of operation and maintenance. A special committee has been appointed and arrangements made to provide a sufficient fund to start the work, and in case the expenditure

should run beyond the amount provided the committe suggests that the various railroads represented in theAssociation should contribute to the fund on a mileage basis or some other basis to be determined by the Board of Directors. Perhaps Mr. Leighty will give us some information of what might be saved in maintenance cost if we could improve on the character of our track.

J. R. Leighty (Mo. Pac.): There is no doubt that greater permanency in the type of tracks would result in considerable saving on the investment under superior or heavy traffic conditions, but under ordinary conditions as we find them and under the ordinary traffic that our main lines have to carry, so far as I can see, we have about as economically maintained and as desirable a track as it is possible to get. I have given some thought to the question of greater permanency and have made some tentative figures on the design, using a continuous concrete base, with I-beams supporting the rail, and under a traffic of about sixty trains per day on one track it would pay a good return on the investment. That seems to be about the point at which departure from its being a good investment would be made.

J. R. W. Ambrose (G. T.): After performing a few experiments, this subject seemed to broaden out and seemed to have larger possibilities. These few crude experiments that we performed show that there is something to be learned from this subject. However, these experiments would only give results in static loads. We could gain nothing from the rolling loads. We are simply trying to find a method by which we can measure these stresses. We have come to the conclusion that there is no formulæ, or anything that we can use in any calculations to do this and whatever results we get must be from experiments. I think these experiments should be performed on different classes of roadway, and perhaps on different conditions of track, at the same location. I don't believe that we can do anything further than to get an apparatus that will measure these stresses in the actual track.

F. E. Turneaure (U. of W.): I have had a little experience in making experiments with a sub-committee of this Association in stresses on bridges under traffic conditions. I think the difficulties in measuring stresses in roadway are more troublesome than in the case of steel structures. If the committee is able, within a year or two, to devise an apparatus to do that work, they will accomplish a great deal. If an apparatus can be devised that will give satisfactory results a great deal can be learned unquestionably from static experiments.

Paul M. LaBach (C. R. I. & P.): The report given in the report of the committee on Roardway, the diagrams and so forth, indicate in a way just exactly what was found in these various tests and show what we could expect to find from a mathematical point of view. When you come to mathematically figure out the strees in the tie itself, the mathematic formulæ are rather long and complicated, but it has been done and can be very readily done again.

W. M. Camp (Ry. & Eng. Rev.): Of course, we understand that the unit pressure of soil has an intimate relation with the elasticity of track supported on that soil. I don't think that finely worked out pressures with regard to allowable stresses on roadbed would be of any importance without knowing the character of the material. A good many think that 8½ ft. is the economical length of tie. With a tie 7 in. thick, as you lengthen it out you increase the tendency for the tie to spring, and when you get a tie sprung the sustaining power of the tie is not satisfactory. As one lengthens the tie he must increase the depth. There is a question in the design of track which is a very practical one, and one which is very readily solved. The question of increasing the bearing surface of the track should be one line of investigation by this committee. Of course that is equivalent to decreasing the pressure on a unit of roadbed. I think it is along those lines, rather than working out nice and neat fomulæ, the best work of the committee can be done, to see in what practical ways this matter of increasing the bearing surface of the track on the soils that we have to deal with.

J. R. Leighty: We have made an effort in the last few years to distribute the axle load over a greater area of roadbed by making the rail deeper or stiffer. Some roads have offset that by lessening the number of ties under the rail length. I could never understand the philosophy of that kind of a move.

John G. Sullivan (C. P. R.): I was on the road committee at one time, and I opposed the making of these experiments for the reason that if you make them under all conditions you will find that you will get earth that will bear from 10 to 15 pounds per square foot, including in the word earth solid rock, up to earth which will bear a locomotive on one square foot, and I cannot see that the results which you will get will be of any practical value. If the committee can bring in a report which will convince the general managers that they should really put on ballast enough to hold the track properly, it may do some good. As a means of education to engineers, it will be simply useless. As far as the ties are concerned, we use some 12-foot ties. They are not to carry the load, however, but to steady the load. The 8-foot tie will break under the rail rather than break in the center. The purpose of using the 12-foot tie is to steady the load and prevent creeping. It is true you should not tamp the tie in the center as hard as you do at the ends, I think you will find you should not go over 8.5 feet to get a uniform loading. If you make it over 8.5 feet you will have the ties breaking under the joint. We have recently tested the strains on the track for different rolling capacity. It was rather surprising to find that every wheel on a locomotive exerted a very great outward pressure. A great many have thought that in the case of an engine running slow the flanges of the trailing drivers will not touch the outside rail. I do not believe in any place did the lateral stress in the track exceed 20 or 22 per cent. of the load on the wheel. Therefore, you get a stress on the track without having the flange strike the head of the rail. The most surprising thing we learned—and these were the results of probably 600 or 800 tests—was that some freight cars exerted a greater pressure on 6 and 8 degree curves than our locomotives.

Hunter McDonald (N., C. & St. L.): There are plenty of roadbeds in the United States, and I am satisfied there are plenty of them in Canada, where it would be practicable to find out what amount of ballast would be needed on the average roadbed. I believe the tendency of to-day is to keep the track just 25 per cent. behind the rolling stock.

Geo. W. Andrews (B. & O.): I believe this committee should continue investigations along the line on which they have been working. Mr. Camp has outlined a method that the committee could give very close attention to.

J. L. Campbell (E. P. S. W.): I would not take exception to these experiments if they would result in impressing the managers to the fact that we need more money for the track. I think the information the committee could secure would be all right, bearing in mind what has been said about the instability of the soil and its carrying capacity under different conditions.

Mr. Ambrose: The moment we study the allowable pressure on roadbed, all the other things come into effect. If the committee is to study it all we should work jointly with the other committee and take the whole under consideration.

The President: The special Committee on Stresses and Tracks expects to take up the study of the entire subject of stresses in track, rails, ties, ballast and roadbed, so that no one feature of the problem will be studied to the detriment of the other.

Mr. Camp: There is another utility in this matter which has not been mentioned, and that is if the committee can ascertain what are the allowable unit pressures on soils as they find them about the country, then if the Association has the courage to do so it can say to the managements of the railroads that the time has come when the motive power departments should stop increasing the weight of the rolling stock.

J. E. Willoughby (A. C. L.): The committee has considered the subject of tunnel construction and ventilation for several years and has tabulated conclusions which appear to be representative for a number of tunnels not more than a mile in length. The committee is of the opinion that as tunnels are ordinarily constructed when the time limit is not of great value, the unit price of the removal of the tunnel section will be less if the heading is driven entirely through, and then the bench be removed afterwards. However, that when material does not require supporting, there are often advantages both in time of construction and in less unit cost in driving a bottom heading first and removing the material by an air or electric shovel.

J. B. Jenkins (B. & O.): With regard to Conclusion 5, which provides that opposing grades should "never" meet between the portals of a tunnel, so as to put a summit in the tunnel, I would say that it is sometimes necessary for the purpose of drainage to have the opposing grades meet between the portals.

C. S. Churchill (C. & N.-W.): I agree with Mr. Jenkins we should not insert anything in our conclusion so absolute as "never," that has been the policy of the Association. The words "preferably not" would be better. There are conditions conceivable in any location where it is possible to have the two ends of the tunnel practically of the same level.

The President: The committee will accept the words "preferably not."

W. H. Courtenay (L. & N.): I agree with the committee that where it is possible to do it there shall be no summit in the tunnel. The summit is an unmitigated nuisance. On the road with which I am connected we have a tunnel which has a summit in it. The tunnel is wet, the trains slip, and it is not an infrequent occurrence that the men on the engine have been overcome by bad air. In nearly all cases, for ordinary tunnels, without reference to such tunnels as those of the New York Terminal or Pennsylvania Railroad, it is entirely practicable to so adjust the grades that there will be no summit in the tunnel.

C. Dougherty (C., N. O. & T. P.): We have a straight tunnel in which, as stated by Mr. Courtenay, the ventilating conditions are better than in shorter tunnels where the summit is provided in the tunnel. I agree with him that it would be better to take care of the water in a tunnel with a uniform grade than to be up against a tunnel with a summit in the middle, providing adequate arrangements were made to take care of the water.

W. B. Storey (Santa Fe): The position taken by Mr. Churchill seems to be proper, in that I know of tunnels that have some summits, and are over a mile long, in which the ventilation does not give trouble. Mr. Jenkins is also right in many cases. It seems, therefore, if the language of the conclusion remains as now accepted by the committee, it is along proper lines, to secure the best practice.

(The conclusions under Tunnel Ventilation were accepted.)

WOODEN BRIDGES AND TRESTLES

The following subjects were assigned for consideration:

(1) Complete report on formulas for use in determining the strength of sheet piling.

(2) Complete report on the use of guard rails for wooden bridges and trestles.

(3) Report on relative economy of repairs and renewals of wooden bridges and trestles.

FORMULAS FOR SHEET PILING.

This topic has been under consideration before the present year and some experimental investigations were undertaken. The equipment installed at first proved to be inadequate for the purpose. The devices for measuring the pressure of the earth had to be changed and it was hoped that after the preliminary work of the preceding year some satisfactory results might be obtained. As is often the case, however, in experimental research, unexpected difficulties and new problems related to the work have arisen so that no fruitful results can be reported this year. While the outlook is now more favorable, it is impossible to predict how soon the work can be completed.

This topic is closely allied to the investigation now being made by Committee VIII on the principles of design of retaining walls, and the experiments of Committee VIII should throw considerable light on the design of sheet piling. The use of sheet piling is seldom required for wooden bridges or trestles, but is a usual accompaniment of the construction of masonry. The committee therefore believes that in order to prevent duplication of experiment, and to serve the best interests of the Association, the report on Formulas for the Use of Sheet Piling should be combined with the report on the principles of Design of Retaining Walls, now being prepared by Committee VIII.

USE OF GUARD RAILS.

This subject has been previously investigated by this committee, which submitted certain conclusions at the last annual meeting, all of which conclusions were adopted except the recommendation in conclusion 2, that guard rails be used on all structures over 35 ft. long, which was referred back to the committee for further consideration and report.

In August, 1913, a circular was sent to the officers in charge of structures of 329 railroads with a total mileage of 276,544, to which 165 replies were received, covering a total of 170,804 miles of track, a summary of which is also given in Appendix A. About 78.9 per cent. of those answering, representing 82.3 per cent. of the railroad mileage answering, recommend guard rails on through bridges. The committee believes the protection of trains and the lives of the passengers and crews to be more important than the protection of structures. If, therefore, guard rails are a protection to through bridges, which means that they assist in guiding a derailed train, they will equally be a protection to trains which may be derailed on deck structures, and are therefore desirable. The committee therefore recommends the adoption of conclusion 5, given below.

At the annual meeting references were made to the danger of brake-rigging catching in the ends of guard rails. The committee believes that this objection can be met by beveling or bending down the ends of guard rails or frog points to the level of the deck, and accordingly recommends the amendment of conclusion 2 as given below.

In changing the wording of conclusion 2 as adopted last year, to eliminate the recommendation to use guard rails on all structures over 35 ft. long, the conclusions were left in such shape as to recommend the use of guard rails. The committee has therefore changed the wording of this paragraph to make it consistent with the other recommendations.

CONCLUSIONS.

(1) Amend conclusion 2, as adopted at the last annual meeting, to read as follows:

"It is recommended as good practice, in the installation of guard rails, to extend them beyond the ends of the bridges for such distance as is required by local conditions, but that this distance, in any case, be not less than 50 ft.; that guard rails be fully spiked to every tie, and spliced at every joint; that the guard rails be some form of metal section; and that the ends be beveled, bent down, or otherwise protected against direct impact with moving parts of equipment."

(2) Adopt conclusion 5 to read as follows:

"It is recommended as good practice to use inner guard rails on all open-floor and on the outside tracks of all solid-floor bridges and similar structures longer than 20 ft. in main-line tracks, and on similar bridges and structures in branch-line tracks on which the speed of trains is 20 miles per hour or more."

The committee recommends that the following subjects be assigned for the ensuing year:

(1) Continue report on relative economy of repairs and renewals of wooden bridges and trestles.

(2) Report on design of docks and wharves.

(3) Report on use of lag-screws for fastening guard timbers.

E. A. Frink (S. A. L.), Chairman; W. S. Bouton (B. & O.), Vice-Chairman; H. Austill, Jr. (L. I.), F. J. Bachelder (B. & O.), J. E. Barrett (L. & H.), F. E. Bissell (Consulting Engineer), E. A. Hadley (M. P.), W. H. Hoyt (D. M. & N.), H. S. Jacoby (Cornell Univ.), P. B. Motley (C. P. R.), A. O. Ridgway (D. & R. G.), I. L. Simmons (C. R. I. & P.), D. W. Smith (H. V.), W. F. Steffens (N. Y. C. & H. R.), H. B. Stuart (G. T.), Committee.

APPENDIX A.

GUARD RAILS FOR BRIDGES AND TRESTLES.

SUMMARY OF ANSWERS TO INQUIRY OF CIRCULAR No. 1

	No.	Per Cent	Mil. Rep.	Per Cent
Number of inquiries sent	329	100	276,542	100
" " replies	165	50.2	170,804	51.7
Number of replies	165	100	170,804	100
" using guard rails on all bridges	30	18.2	15,039	8.8
" " " " " some "	117	71.0	151,348	88.6
" " " " " no "	18	10.9	4,417	2.5
" advising use on all bridges	49	29.7	54,523	31.9
" " " " movable bridges	115	69.8	132,912	77.8
" " " " through "	130	78.9	140,556	82.3
" " " " deck "	108	65.5	95,658	56.0
" " " " timber trestles	94	57.0	73,830	43.2
" " " " solid-floor structures	60	36.4	59,460	34.8
" not advising use on all bridges	5	3.0	3,367	1.9
" " " " " movable bridges	16	9.7	15,269	8.9
" " " " " through "	7	4.2	4,726	2.7
" " " " " deck "	13	7.9	5,977	3.5
" " " " " timber trestles	13	7.9	6,093	3.6
" " " " " solid-floor structures	38	23.0	22,603	13.2
" reporting cases where guard rail prevented damage	84	50.9	103,317	60.5
" reporting cases where guard failed	33	21.3	60,156	35.2

Discussion on Wooden Bridges and Trestles.

The report was read by E. A. Frink, chairman of the Committee.

(Conclusion No. 1 was adopted.)

A. W. Carpenter (N. Y. C. & H. R.): I would like to ask the committee the reason for the exclusion of the use of the inner guard rail in conclusion No. 2 and recommending the use of the inner guard rail only on the outside tracks of solid floor bridges.

Mr. Frink: The committee considered that the definition of solid floor bridge would mean that the solid floor was one level floor surface.

Mr. Atwood: The railroads in the South and West have so much timber work that this conclusion would be a terrible burden.

Mr. Campbell: We have a great many pile bridges, which we consider form permanent structures, all of which have solid floors, some of which are considerably over 20 ft. in length. We also have quite a number of concrete bridges over 100 feet in length. We have no inner guard rails on bridges of that kind on our road, and do not consider it necessary.

C. F. Losh (N. & W. Ry.): I would like to ask the committee what the twenty miles an hour has to do with it.

Mr. Frink: We realize that there should be some distinction made between main line structures and rather unimportant branch line structures. We tried to find some way to measure that difference and the requirement of twenty miles speed was the only way that we could measure it.

Mr. Lindsay: I rise to oppose the recommendation. While it is true that this is a committee on Wooden Bridges and trestles, whatever we adopt here as a definition or as to location will naturally extend to the use of similar devices on a more permanent structure. I am not opposed to the use of the inner guard rail where it will minimize accidents, but there are places where it will not serve that purpose. Every day regulations being made by different legislative bodies as to what railroads shall do, how they shall build their structures and run their roads. Why lag behind and allow different legislatures tell you what to do? These conclusions

E. A. FRINK,
Chairman Committee on Wooden Bridges and Trestles.

were arrived at so that they could be used by the legislatures and thus prevent them from starting in with some wild scheme that is absolutely impracticable. We agree that there is no question that there are locations where inside guard rails are not needed. I should dislike to see this body refuse to make some recommendation upon this subject, for I consider it important. In some states the question is being considered now as to passing regulative legislation on this subject. We should lead in this and not lag behind.

Prof. Williams: I wish to express myself as heartily in favor of the recommendation of the committee. We are interested in all matters which affect the safety of the traveling public, and as railway men we are interested in that which affects the safety of railway property. This recommendation seems to me extremely valuable, and does not carry the weight of direction—it is not mandatory. It puts before every railway company and every engineer the question of safety for its trains and for the public.

G. W. Andrews (B. & O.): I could recall a number of cases where the inner guard rail has prevented cars, tenders and even engines from going over into the opening under the trestle of the bridge when so protected. We cannot take the stand, from an economical standpoint, that inner guard rails should not be advocated. One serious accident at any one bridge would come very nearly paying for the entire cost of the guard rails, not mentioning the loss of prestige of the road.

Mr. Morse: I think we are apt to go to extremes in this matter. If we were all millionaires and had lots of money, we could all have them, but we have not money enough for them. I think if we recommend the inner guard rail on long bridges and also on branch lines, that we ought to make the speed exceed twenty miles an hour.

Mr. Sullivan: I am heartily in favor of the guard rails. We use them on all of our bridges that are over 100 feet long. We use them on curves and in tunnels and other dangerous points. It is in the interest of the company to avoid accidents. We are trying to protect the company and to protect the public from the pettifogging lawyers. The public have got to pay for putting on guard rails in the long run.

Mr. Churchill: I believe the Association would make a mistake to adopt conclusion No. 2 in its present form. I think that we are well protected by the form that is now in the Manual. We use inner guard rails on curves, on tunnels, but we believe as railroad men that we ought to be the judges, and certainly 20 feet is away below any sensible figure for the limitation of the inner guard rail.

Mr. Lindsay: Mr. Sullivan and Mr. Churchill have voiced my sentiments exactly. I am not opposed to guard rails. I favor them. I yield to no man when it becomes a question of the safety of the public, but I do not think that we ought to put the public to unnecessary expense. I would like to see that recommendation read something like this: "Where operating conditions warrant a guard rail should be installed on bridges of more than 30 ft. span—(a) on any track where the superstructure projects above the ties and adjacent thereto; (b) on single and double track, and (c) on track structures."

Mr. Carpenter: I agree with a number of the speakers that we should not call for inner guard rails on all structures.

Mr. Frink: This recommendation has been under way two years. The first time one or more inquiries were sent out to the roads and about 61 replies were obtained. Of that number 25 reported the use of guard rails on all structures and 54 reported using them on some structures. From the remarks and other evidence submitted in answer to that circular the committee felt at that time perfectly justified in recommending the use of guard rails on all structures. The committee sent out another set of inquiries, the result of which is briefly summarized in our report. Of the 165 replies we received, 18 per cent. reported using guard rails on bridges; 71 per cent. reported using it on some, and practically 11 per cent. on none. When it came to the personal opinion of the members, 29.7 per cent. recommended using on all bridges; 69.8 per cent. on movable bridges; 78.9 per cent. on through bridges; 65.5 per cent. on deck bridges; 57 per cent. on timber trestles, and 36 per cent. on solid floor structures. With the exception of the solid floor structures, more than a majority of members replying advised the use of guard rails. We have consulted the members of the Association, and all of that information points to the general opinion of the members of the Association being in favor of the general use of guard rails. One thing that bears on this subject is the action that has been taken by various civic bodies in regard to the use of guard rails. The laws of New York State impose a penalty of $500 for each offence. In 1887 there was a bad bridge wreck at White River Junction and the road was criticized for not having guard rails. I do not think there is any question that in any other accident that might be traceable to the same cause, or was not traceable to that cause, but was a structure without guard rails, would lead to the same kind of criticism. I do not see, from the information the committee has gotten from the various members who answered their inquiry, that it was possible to bring in any other conclusion than that which we have brought in.

(A rising vote was then taken on the adoption of the conclusion, resulting in 115 votes for the adoption, and 75 votes against the adoption of the conclusion.)

IRON AND STEEL STRUCTURES

The subjects assigned for investigation during the past year were:

(1) Report on the methods of protection of iron and steel structures against corrosion.

(2) Study the design of built-up columns, co-operating with other investigators and committees of other societies.

(3) Report on design and length of turntables.

(4) Report on the relative economy of various types of movable bridges for varying lengths of span.

In addition to these subjects, there remained from the preceding year unfinished business as follows:

(5) Investigation of secondary stresses and impact.

(6) Adaptation of designs of movable bridges to signal and interlocking appliances required.

(7) Specifications for phosphor bronze.

(8) Bridge clearance diagram.

(9) Revision of the Manual: Specifications for elastic limit; revision of paragraph 23 of "Instructions for the Inspection of the Fabrication of Steel Bridges."

The committee submitted a final report on "Methods of Protection of Iron and Steel Structures Against Corrosion" in Appendix A as information and without recommendation.

The study of the Design of Built-up Columns made but little progress during the year. Considerable delay was encountered in securing material for the columns in the first series of tests.

Progress was made on the subject of Design and Length of Turntables. It was recommended that this subject be continued during the coming year.

The Relative Economy of Various Types of Movable Bridges for Varying Lengths of Span covers such a diversity of conditions as not to admit of the formulation of principles of general application. It was therefore recommended that the committee be relieved from its consideration for the present.

The Investigation of Secondary Stresses and Impact was reported on in Appendix C. This material was submitted as a progress report and the subject should be re-assigned for further study.

The "Adaptation of Designs of Movable Bridges to Signal and Interlocking Appliances Required" has been the subject of careful study by a joint sub-committee representing committees II and III of the Railway Signal Association, and committees X and XV of the American

A. J. HIMES,
Chairman Committee on Iron and Steel Structures.

Railway Engineering Association. The final report was presented in Appendix D, and is recommended for adoption and publication in the Manual.

A Specification for Phosphor Bronze received some discussion during the year, and considerable information was received. However, it was not in shape for presentation to the Association.

The Bridge Clearance Diagram was made the subject of an exhaustive study. Any changes in the present diagram will have such far-reaching importance that no change should be made hastily, and the work of the committee has thus far consisted in the compilation of prevailing opinions and practices on the various roads. This information was shown in Appendix E, and was submitted as a progress report. It was recommended that the investigation be continued.

The committee made no report on the specifications for the Elastic Limit.

Paragraph 23 of "Instructions for the Inspection of the Fabrication of Steel Bridges," page 88, of Volume 14 of the Proceedings, was amended to read as follows:

"23. Have the assembling of trusses and girder spans required by the specifications carefully done and in any case insure the accuracy of field connections. If a large number of duplicate parts are to be made, the number of parts to be assembled should be governed by the workmanship. If errors are found, a sufficient number of parts should be assembled to make it reasonably certain that such errors have been eliminated."

This paragraph was recommended for adoption and publication in the Manual.

The following additional clauses for the inspection of the fabrication of steel bridges were submitted for adoption and publication in the Manual:

"1. Check every finished member against the drawings for its general dimensions and for the section of each piece of material forming a component part of the member.

"2. Attend the weighing of material whenever practicable, especially that purchased on weight basis. Check the accuracy of the scales with test weights or by other sufficient means."

CONCLUSIONS.

The committee recommended that:

(1) The report on methods of protection of iron and steel structures against corrosion be received as information.

(2) The report on secondary stresses be received as information.

(3) The report on requirements for the protection of traffic at movable bridges be adopted and published in the manual.

(4) The report on bridge clearance diagram be received as information.

(5) Revised paragraph 23 of "Instructions for the Inspection of the Fabrication of Steel Bridges" be adopted and published in the manual. That the two additional clauses relating to the same subject be adopted and published in the manual.

A. J. Himes (N. Y. C. & St. L.), Chairman; O. E. Selby (C. C. C. & St. L.), Vice-Chairman; J. A. Bohland (G. N.), A. W. Buell (Consulting Engineer), A. W. Carpenter (N. Y. C. & H. R.), Charles Chandler (I. C.), C. L. Crandall (Cornell University), J. E. Crawford, N. & W.), F. O. Dufour (Consulting Engineer), W. R. Edwards (B. & O.), William Michel, (H. V.), W. H. Moore (N. Y. N. H. & H.), Albert Reichmann (Am. Br. Co.), C. E. Smith (M. P.), I. F. Stern (Consulting Engineer), G. E. Tebbetts (Kansas City Terminal), F. E. Turneaure (Univ. of Wis.), L. F. Van Hagan (Univ. of Wis.), Committee.

APPENDIX A.

Methods of Protection of Iron and Steel Structures Against Corrosion.

Pigments.—Pigments may be divided into three classes, in respect to their action upon steel in water, each of which merge into the next by easy steps, so that the line of demarcation is difficult to ascertain. These classes are the "inhibitive," the "neutral" (inerts or indeterminate), and the "stimulative." The "inhibitive" pigments retard rust, the "stimulative" hasten the corrosion, while the "inerts" are an intermediate class which apparently leaves the material in much the same condition as it was originally, the only protective action being that of a covering pure and simple.

Pigments may further be divided according to their ability to exclude and to shed moisture. A pigment may exclude the moisture and still be of such a surface character as to allow it to stand upon the surface until it evaporates or is absorbed; or a pigment may have such surface characteristics that the moisture will run off. A "shedding" pigment may be a greater absorber of moisture than an "excluder" and still be a superior protection, according to the conditions of location. Strong inhibitors may be weak "excluders" or "shedders," while "stimulators" may have high qualities as "excluders" or "shedders."

Pigments may have different coefficients of expansion and "drying" and different modulii of elasticity. In cases where great differences obtain in any or all of these properties, the surface may "alligator" or crack. In some cases the finishing coat has "alligatored" along the priming coat, which was of a different color, and this shows through.

Investigators have concluded that the size of the pigment particles is important and that the law of minimum voids holds true in the preparation of protective coatings, as well as in concrete. Therefore, either various proportions of the same pigment, which have different degrees of fineness, or the mixing of pigments of different degrees of fineness, would seem to be advisable. The spreading value of a pigment is an important consideration, secondary, of course, to its protective action, but still influencing it. Too high a spreading quality causes films to paint too thin to withstand the actions of the deteriorating influences.

Investigators appear to have come to the conclusion that bituminous coatings protect metal better than any other, but that the action of sunlight readily destroys their life and, hence, the value, and that, therefore, they are

practically of no value as a protective agent where subjected to the action of light.

From the preceding it appears that priming coats should always be inhibitors, whether or not they are excluders or shedders; finishing coats should be excluders or shedders; shedders preferably, whether or not they are inhibitors, neutrals or stimulators; care must be taken to consider the deteriorating influence and determine the chemical requirements of the pigment accordingly; in cases where a pigment appears in more than one class, care should be taken to determine its process of manufacture before using it as a priming coat; and that the best results will probably be obtained by using an "inhibitive" and "excluder" or "shedder" pigment for both priming and finishing coats.

Table 1 gives the classes to which commonly-used pigments belong:

TABLE 1—CLASSIFICATION OF PIGMENTS (CUSHMAN)

Inhibitors	Indeterminates	Stimulators
Zinc and Lead Chromate	White Lead (Quick Process, Basis Carbonate)	Lamp-black
Zinc Oxide	Sublimed White Lead (Basic Sulphate)	Precipitated Barium Sulphate (Blanc Fixe)
Zinc Chromate	Sublimed Blue Lead	Ochre
Zinc and Barium Chromate	Lithopone	Bright Red Oxide
Zinc Lead White	Orange Mineral (American Red Lead)	Carbon Black
Prussian Blue (inhibitive)	Litharge	Graphite No. 2
Chrome Green (Blue tone)	Venetian Red	Barium Sulphate (Barytes)
White Lead (Dutch process)	Prince's Metallic Brown	Graphite No. 1
Ultramarine Blue	Calcium Carbonate (Whiting)	Prussian Blue (Stimulative)
Willow Charcoal	Calcium Carbonate (Precipitated)	Linseed Oil
	Calcium Sulphate	
	China Clay	
	Asbestine	
	American Vermilion	
	Medium Chrome Yellow	

From this it is seen that the carbon and graphite paints should not be used as primers, that the zinc and lead pigments are good primers, while the lead basis may belong to either class, according to their method of manufacture.

[The elaborate experiments of the American Society for Testing Materials on preservative coatings for iron and steel on the Havre de Grace bridge were reviewed at length. These experiments have been abstracted in the columns of the Railway Age Gazette from time to time. An abstract of the report of the committee on Painting of Structural Iron and Steel of the American Railway Bridge and Building for 1912 was also included. This report was printed in the Railway Age Gazette for October 18, 1912.—Editor.]

Concrete Encasement.—Concrete encasement has come into use as a protective agent for that portion of steel strutures exposed to the blast and gases of locomotives due to the trouble experienced with paint and to the cost of maintenance of the same. We believe that concrete properly applied is an ideal protection will be conceded by everyone interested, even though they do not generally use it. The use of the concrete encasement is in a way limited by railroads to undercrossings and to city bridges where the headroom is close and the railroad traffic heavy.

In the above locations protecting floors by the use of paint is at best unsatisfactory and, while varying with the conditions, the cost will be somewhere in the neighborhood of $1.25 per ton per year. A fair average relation of weight to area is .065 sq. ft. per lb. of metal, this giving a cost of 0.96 cents per sq. ft., per year, for painting. If the floor is protected by the use of concrete encasement poured in place, the cost per sq. ft. will be approximately 25 cents per sq. ft., the encasement being 3 in. in thickness. Encasing the floor 3 in. in thickness by the cement gun, will cost approximately 23 cents per sq. ft.

At bridges and undercrossings where the headroom is close, the lower portions of the structure should be protected by smoke shields if the floor is not encased in concrete or by blast boards over each track if the steel is encased. As shown below in the replies received by the committee, the concrete encasement is rapidly worn away by sand blast action if unprotected. A variety of materials are in use for this purpose, including timber, steel, vitrified tile and asbestos boarding.

APPENDIX C.

Secondary Stresses.

During the summer of 1911 a considerable amount of experimental field work was carried out, observations being made on several trusses representing quite a variety of design. The results were, in general, quite satisfactory and instructive. The committee has also made a theoretical study of some length on various types of trusses and has compared, to some extent, results obtained by calculation and by observation.

Considering the results of these observations and calculations and the general principle that to a great extent secondary stresses are proportional to the ratios of widths to lengths of members, it may be said that the secondary stresses of the kind here discussed in ordinary trusses should not exceed 40 per cent for a ratio of width to length of one tenth, or, expressed more generally, should not exceed $4\times\frac{\text{width}}{\text{length}}$. If subdivided panels are not used, it is probably practical to keep the ratio of $\frac{\text{width}}{\text{length}}$ sufficiently low so that the secondary stresses will not exceed 35 per cent.

In the bottom chords of through trusses a value of $5\times\frac{\text{width}}{\text{length}}$ is likely to be reached, but here the ratio $\frac{\text{width}}{\text{length}}$ can be kept somewhat lower than in compression members, so that ordinarily the secondary stress need not exceed 30 to 35 per cent.

Special attention should be given to secondary stresses in trusses with sub-divided panels, as these are likely to reach very high values, due, primarily, to high ratios $\frac{\text{width}}{\text{length}}$, but also to the distortion of the hangers and sub-members.

APPENDIX D.

Requirements for the Protection of Traffic at Movable Bridges.

The protective appliances at drawbridges consist in devices for insuring that the bridge is in proper position and the track in condition for the passage of trains over the draw, or for the reduction to a minimum of the damage in case of trains not stopping when the track is not in condition for their passage over the draw; also the usual devices for protection against damage in case of derailment.

The protective devices may be classified under the headings: Interlocking power and bridge devices; bridge surfacing, alining and fastening devices; rail end connections; signaling and interlocking; and guard rails.

If trains are to proceed over drawbridges which are in service, without first stopping, interlocking should be installed which will provide that the draw span, tracks and switches within the limits of the plant are locked in the proper position. This will require locking drawbridge devices and locking providing for the proper order of operation of signaling devices, such as signals, switches and derails.

There should be two lines of guard rails of rail section, placed between the running rails, which should extend from the approaches continuously over the bridge, except for the necessary breaks at the ends of the draw span. The top of the guard rails should preferably be level with the top of the main rail and not in any case more than one inch below it. There should be a clear space of ten inches between the head of the guard rail and the gage side of the main rail. The guard rails should be full spliced and bolted and be fastened at the same intervals and by the same methods as the main rail. Obstructions to derailed wheels which are guided by the guard rails should be reduced to a minimum. The guard rails shall be brought together at a point not less than 75 ft. beyond the ends of the bridge, the ends of the rails to be beveled or otherwise effectivelv formed so that dragging objects will be deflected. When traffic is in one direction, the guard rails should be extended as described on the approaching end of the bridge only.

APPENDIX E.

Bridge Clearance Diagram.

At the request of the committee, a circular letter was sent out to railway officers to obtain information to aid

in the study of the bridge clearance diagram. As no recommendation is to be made by the committee this year, the replies received were presented as information. From these it is noted that there is quite a general feeling that the whole clearance diagram should be considered, rather than a modification for third rail. It should also be noted that some of the public service commissions are taking action and in some cases fixing dimensions which will seriously increase the cost for portal and vibration bracing without increasing safety.

Discussion on Iron and Steel Structures.

A. J. Himes, chairman, read the report.

A. W. Carpenter: In Appendix A the committee has set forth a thorough classification of pigments, which is known as the inhibitive and stimulative theory, and it has set it forth in such a manner as to make it appear as if that were a fully accepted theory. Now, I believe that this theory is not fully accepted and that the committee should have so stated, and I believe that the classification that is shown in Table 1 is not proper to apply to commonly used pigments. I, therefore, think that the committee, in reporting in this way, without stating in any way the limitations of the theory or classifications shown, is not offering the information in the proper shape to the Association. I hope that they will revise their report in those respects.

The President: The committee does not submit this with the idea of publishing it in the Manual, but desires to have it received as information. In view of the remarks by Mr. Carpenter it may be well for our membership to carefully read this Appendix later on and submit suggestions in writing.

Conclusion No. 2 was then explained by Mr. Himes and Prof. Turneaure. The meeting was then adjourned, the discussion being postponed to the next session.

REGISTRATION—AMERICAN RAILWAY ENGINEERING ASSOCIATION

Abbott, F. E., Insp. Eng., Lackawanna Steel Co., Buffalo, N. Y.
Abbott, George W., Div. Eng., B. & A. R. R., Boston, Mass.
Adamson, J. H., Asst. Div. Eng., B. & O. R. R., Baltimore, Md.
Ambrose, J. R. W., Eng. Grade Sep., Grand Trunk Ry., Toronto, Can.
Ames, Azel, Kerite Insulated Wire and Cable Co., New York.
Andrews, Geo. W., Insp. of Maint., B. & O. R. R., Baltimore, Md.
Andrews, J. T., Eng. Dept., B. & O. R. R., Baltimore, Md.
Angier, F. J., Supt. Tim. Pres., B. & O. R. R., Baltimore.
Anthony, C. C., Asst. Sig. Eng., P. R. R., Philadelphia, Pa.
Anthony, F. D., Const. Eng., D. & H. Co., Albany, N. Y.
Armour, Robert, Masonry Eng., Grand Trunk Ry., Montreal, Can.
Armstrong, H. J., Asst. Prof. C. E., Armour Inst., Chicago, Ill.
Arn, W. G., Roadmaster, I. C. R. R., Mattoon, Ill.
Ashbaugh, C. A., Div. Eng., G. C. & S. F. Ry., Cleburne, Tex.
Ashby, E. B., Chief Engr., Lehigh Valley R. R., New York, N. Y.
Atwood, J. A. (Director), Chief Eng., P. & L. E. R. R., Pittsburgh, Pa.
Austill, H., Jr., Bridge Eng., M. & O. R. R., Mobile, Ala.
Bachelder, F. J., Div. Eng., B. & O. R. R., Cleveland, Ohio.
Backes, W. J., Engr. M. W., N. Y. N. H. & H. R. R., New Haven, Conn.
Barnes, O. F., Trainmaster, Erie R. R., Susquehanna, Pa.
Bates, Onward, Con. Engr., Chicago, Ill.
Beach, D. P., Div. Eng., Penna. Lines West of Pittsburgh, Indianapolis.
Beal, L. L., Chief Engineer, A. B. & A. R. R., Atlanta, Ga.
Beebe, H. R., Railroad Contractor, Utica, N. Y.
Berry, J. B., Asst. to Prest., C. R. I. & P. Ry., Chicago, Ill.
Beye, John C., Loc. Eng., C. R. I. & P. Ry., Chicago, Ill.
Billman, H. E., Div. Eng., Mo. Pac. Ry., St. Louis, Mo.
Bisbee, F. M., Engr. W. L., Santa Fe. Ry., Amarillo, Tex.
Bissell, F. E., Cleveland, Ohio.
Black, G. F., Eng. M. W., Maine Central R. R., Portland, Me.
Blackman, Chas. H., Asst. Eng., L. & N. R. R., Louisville, Ky.
Blaess, A. F., Dist. Eng., I. C. R. R., Chicago, Ill.
Blaieklock, M. S., Engr. M. of W., Grand Trunk Ry., Montreal, Can.
Blanchard, M. C., Office Eng., A. T. & S. F. Ry., Topeka, Kan.
Bowser, E. H., Supt. Timber Dept., I. C. R. R., Memphis, Tenn.
Boyden, R. T., Transitman, S. N. E. R. R., Millville, Mass.
Boynton, C. W., Ch. Insp. Eng., Universal Portland Cement Co., Chicago, Ill.
Bremner, Geo. H. (Treasurer), Asst. Dist. Eng., Interstate Commerce Commission, Chicago.
Bridgman, J. N., Asst. Prof., C. E., Univ. of Nebraska, Lincoln, Neb.
Brooke, G. D., Supt., B. & O. R. R., Winchester, Va.
Brooks, N. E., G. M. and C. E., Guantanamo Ry., Guan., Cuba.
Brown, E. C., Chief C. E., Carnegie Steel Co., Pittsburgh, Pa.
Brown, H. C., Jr., Asst. Engr., I. C. R. R., Chicago, Ill.
Brown, H. W., Asst. Div. Eng., Penna. Lines, Cleveland, Ohio.
Brumley, D. J., Asst. Chief Engr., I. C. R. R., Chicago, Ill.
Brunner, John, Asst. Insp. Eng., Ill. Steel Co., Chicago.
Burgess, G. H., Chairman Val. Com., D. & H. Co., Albany, N. Y.
Burns, J. F., Asst. Eng., M. W., L. & N. R. R., Louisville, Ky.
Burpee, Moses, Ch. Eng., B. & A. R. R., Houlton, Me.
Burt, A. M., Chief Eng. M. W., N. P. Ry., St. Paul, Minn.
Burton, W. J., Asst. Eng., Mo. Pac. Ry., St. Louis, Mo.
Camp, W. M., Editor, Railway and Eng. Review, Chicago, Ill.
Campbell, A. Q., Des Moines, Iowa.
Campbell, J. L., E. M. W., E. P. S. W. Ry. System, El Paso, Tex.
Carothers, J. B., Asst. to Gen. Man., B. & O. S. W., Cincinnati, Ohio.
Carpenter, A. W., Val. Eng., N. Y. C. & H. R. R. R., New York.
Case, A. D., Eng. Str., B. & A. R. R., Boston, Mass.
Cassil, H. A., Div. Eng., B. O. S. W. R. R., Seymour, Ind.
Causey, W. B., Supt., C. G. W. R. R., St. Paul, Minn.
Chamberlain, O. P., Chicago, Ill.
Christian, W. A., First Asst. Eng., C. G. W. R. R., Chicago, Ill.
Christofferson, C. A., Signal Eng., N. P. Ry., St. Paul, Minn.
Church, H. M., Dist. Eng. M. W., B. & O. R. R., Wheeling, W. Va.
Churchill, Chas. S., Past President, Asst. to Pres., Norfolk & Western Ry., Roanoke, Va.
Clark, W. A., Chief Engineer, D. & I. R. R. R., Duluth, Minn.
Clement, S. B., Chief Engineer, T. & N. O. Ry., North Bay, Ont.
Cleveland, G. C., Chief Engr., L. S. & M. S. Ry., Cleveland, O.
Clift, A. E., Gen. Supt., I. C. R. R., Chicago, Ill.
Coburn, Maurice, Prin. Asst. Engr., Vandalia R. R., St. Louis, Mo.
Coles, W. C., Field Engr., B. & O. R. R., Baltimore, Md.
Condron, T. L., Consulting Engr., Chicago, Ill.
Conner, J. K., Chief Engr., L. E. & W. R. R., Indianapolis, Ind.
Courtenay, W. H., Chief Engr., L. & N. R. R., Louisville, Ky.
Cox, J. B., Consulting Engr., Chicago, Ill.
Crandall, C. L., Prof. of Ry. Eng., Cornell Univ., Ithaca, N. Y.
Crawford, J. E., Chief Engr., Norfolk & Western Ry., Roanoke, Va.
Cronican, W. P., Asst. Engr., I. C. R. R., Chicago, Ill.
Crosby, Ward, Chief Engr., C. C. & O. Ry., Johnson City, Tenn.
Crowell, F. N., Div. Engr., Penna. Lines, Cincinnati, O.
Crumpton, Arthur, Asst. Engr., G. T. R., Port Hope, Ont., Can.
Cunningham, A. O., Chief Engr., Wabash R. R., St. Louis, Mo.
Curd, W. C., Drainage Engr., Mo. Pac. Ry., St. Louis, Mo.
Curtis, L. G., Dist. Engr., B. & O. C. Ter. R. R., Chicago, Ill.
Cushing, W. C., Past President, Ch. Eng. M. of W., S. W. Sys., Penna. Lines, Pittsburgh, Pa.
Cutler, A. S., Asst. Prof. Ry. Engr., Univ. of Minn., Minneapolis, Minn.
Darling, W. L., Director, Chief Engr., N. P. Ry., St. Paul, Minn.
Davidson, Geo. M., Chemist and Eng. Tests, C. & N. W. Ry., Chicago, Ill.
Dawley, W. M., Asst. Engr., Erie R. R., New York, N. Y.
Dawley, W. S., St. Louis, Mo.
Dearborn, W. A., Supr. of Tr., B. & A. R. R., Pittsfield, Mass.
Denney, C. E., Spl. Engr., New York Central Lines, Chicago, Ill.
Dennis, Walt. Asst. Engr., C. R. I. & P. Ry., Chicago, Ill.
Dickson, J. B., Asst. Gen. Man., Erie R. R., Cleveland, Ohio.
Donahey, J. L., Ch. Engr., A. C. & Y. Ry., Akron, Ohio.
Dorrance, W. T., Chief Engr., Boston Ter. R. R., Boston, Mass.
Dougherty, C., Chief Engr., C. N. O. & T. P. Ry., Cincinnati, O.
Douglas, H. T., Jr., Chief Engr., C. & A. Ry., Chicago, Ill.
Downs, L. A., Supt., I. C. R. R., Dubuque, Ia.
Dufour, F. O., Athens, Pa.
Dunham, Chas. A., Signal Engr., G. N. Ry., St, Paul, Minn.
Earle, Thos., Supt. B. & C. Dept., Penna. Steel Co., Steelton, Pa.
Eaton, W. T., Ch. Engr., St. L. S. W. R. R., of Texas, Tyler, Tex.
Eck, W. J., Electrical Engineer, Sou. Ry., Washington, D. C.
Edmondson G. N., Div. Engr., N. Y. C. & H. R. R. R., Rochester, N. Y.
Edwards, J. H., Asst. Ch. Engr., American Bridge Co., Passaic, N. J.
Edwards, L. N., Supr. Engr., Bridges, Dept. of Works, Toronto, Can.
Elliott, W. H., Signal Engineer, N. Y. C. & H. R. R. R., Albany, N. Y.
Ellis, G. E., Sig. Engr., K. C. Ter. Ry., Kansas City, Mo.
Entwisle, E. D., Ch. Engr., J. & S. C. R. R., Johnstown, Pa.
Evans, John, Div. Engr., M. C. R. R., Detroit, Mich.
Fairbairn, J. M. R., Asst. Ch. Engr., C. P. R., Montreal, Can.

Fairchild, Dennison, Superv. B. and B., Nor. Pac. Ry., Minneapolis, Minn.
Faucette, W. D., Chief Engineer, S. A. L. Ry., Norfolk, Va.
Faulkner, L. E., Act. Ch. Engr., Miss. Cent. R. R., Hattiesburg, Miss.
Felt, C. F. W., Chief Engineer, Santa Fe Railway System, Chicago, Ill.
Fernstrom, H., Chief Engineer, Va. Ry., Norfolk, Va.
Fisk, C. H., Consulting Engr., St. Louis, Mo.
Fitzpatrick, P. D., Div. Engr., S. N. E. Ry., Providence, R. I.
Flora, G., R. F. D., Rhodes, Ia.
Ford, C. F., Supr. of T. & T. Dept., C. R. I. & P. Ry., Chicago.
Ford, R. H., Engr., Tr. Elev., C. R. I. & P. Ry., Chicago, Ill.
Freeman, F. B., Ch. Engr., B. & A. R. R., Boston, Mass.
Frink, E. A., Bridge Engr., Seaboard Air Line Ry., Portsmouth, Va.
Fritch, E. H. (Secretary), Chicago, Ill.
Fritch, L. C. (Past-President), Chief Engr., Chicago Great Western R. R., Chicago, Ill.
Fulks, E. B., Louisville, Ky.
Galloway, C. W., Gen. Man., B. & O. R. R., Baltimore, Md.
Gardner, W. H., Jr., Ch. Engr., G. & S. I. R. R., Gulfport, Miss.
Gersbach, Otto, E. M. W., Ind., Harbor Belt R. R., Gibson, Ind.
Gilbert, G. H., Engr. B. & B., Queen & Crescent Route, Cincinnati, Ohio.
Given, W. H., Asst. Gen. Man., W. C. F. & N. Ry., Waterloo, Ia.
Glass, R. G., Asst. Insp. Engr., Ill. Steel Co., Chicago, Ill.
Godlove, Geo. W., Jr., Transitman, A. T. & S. F. Ry., Marcelline, Mo.
Going, A. S., Engr. Const., Grand Trunk Ry., Montreal, Can.
Gordon, H. L., Asst. Engr., B. & O. R. R., Baltimore, Md.
Griswold, H. C., Asst. Inspecting Engr. I. St. Co., Chicago, Ill.
Guy, Frank L., Div. Engr., A. T. & S. F. Ry., Topeka, Kan.
Hadley, E. A., Asst. Engr., Mo. Pac. Ry., St. Louis, Mo.
Hamilton, H. F., Res. Engr., G. N. Ry., St. Paul, Minn.
Hannaford, A. R., Bridge Insp., Grand Trunk Ry., Toronto, Ont.
Harris, G. W., Ch. Engr., Coast Lines, Santa Fe, Los Angeles, Cal.
Hartley, L. C., Chief Engr., Chicago & Eastern Illinois R. R., Chicago, Ill.
Harvey, D. F., Supr., P. & L. E. R. R., Beaver Falls, Pa.
Harvey, W. C., Asst. Engr., C. G. W. R. R., Chicago, Ill.
Harwood, G. A., C. E. Elec. Zone Impr., N. Y. Cen., New York.
Hastings, E. M., Res. Engr., R. F. & P. R. R., Richmond, Va.
Hawk, A. T., Architect, Rock Island Lines, Chicago, Ill.
Hedgcock, J. A., Term. Engr., A. C. & H. B. Ry., Sault Ste Marie, Ont.
Hendricks, V. K., Asst. Chief Eng., St. L. & S. F. R. R., St. Louis, Mo.
Hewson, E. G., Div. Engr., G. T. Ry., Toronto, Ont., Can.
Hickey, T. H., Roadmaster M. C. R. R., St. Thomas, Ont.
Hill, C. C., Engr. Const., M. C. R. R., Detroit, Mich.
Himes, A. J., Val. Engr., N. Y. C. & St. L. R. R., Cleveland, O.
Holden, J. C., Div. Engr., C. P. R., Winnipeg, Man, Can.
Hotchkiss, L. J., Chicago, Ill.
Houghton, E. R., Asst. Eng., U. P. R. R., Omaha, Neb.
Howard, C. P., Con. Engr., Chicago, Ill.
Howe, C. H. R., Div. Engr., B. & O. R. R., Cincinnati, Ohio.
Howson, E. T., Civil Engr. Editor, Railway Age-Gazette, Chicago, Ill.
Hoyt, W. H., Asst. Ch. Engr., D., M. & N. R. R., Duluth, Minn.
Hughes, L. J. F., Div. Engr., C. R. I. & P. Ry., Herington, Kan.
Hughes, Wm. M., Consulting Bridge Engr., Chicago, Ill.
Humphrey, Richard L., Consulting Engr. and Chemist, Philadelphia, Pa.
Ibsen, Hans, Bridge Engr., M. C. R. R., Detroit, Mich.
Irwin, J. C., B. & A. R. R., Boston, Mass.
Jackson, E. D., Div. Engr., B. & O. R. R., Philadelphia, Pa.
Jacoby, H. S., Prof. of Bridge Engr., Cornell Univ., Ithaca, N. Y.
Jenkins, J. B., Valuation Engr., B. & O. R. R., Baltimore, Md.
Johns, C. W., Engr., Branch Lines, C. & O. Ry., Richmond, Va.
Johnson, G. P., Gen. Man., C. & O. Ry., Richmond, Va.
Johnston A. W. (Past-President), Gen. Man., N. Y. C. & St. L. R. R., Cleveland, Ohio.
Johnston, D. B., Div. Engr., Pa. Lines, Louisville, Ky.
Jordan, S. A., Dist. Engr. M. of W., B. & O. R. R., Baltimore, Md.
Jurgensen, D. F., Ch. Engr., Minnesota Railroad and Warehouse Commission, St. Paul, Minn.
Katte, E. B., Ch. Engr. E. T., N. Y. C. & H. R. R. R., New York, N. Y.
Kelley, Howard G. (Past-President), Vice-Pres., Grand Trunk Ry. System, Montreal, Can.
Kent, A. S., Chief Engr., C. I. & L. Ry., Chicago, Ill.
Kirby, J. L., Div. Engr., S. A. L., Atlanta, Ga.
Knight, H., Div. Engr., Erie R. R., Jersey City, N. J.
La Bach, Paul M., Asst. Engr., C., R. I. & P. Ry., Chicago, Ill.
Lacher, W. S., Office Engr., C. M. & St. P. Ry., Chicago, Ill.
Laird, E. P., Engr. of Rdwy., A. C. L. R. R., Rocky Mount, N. C.
Lamphere, F. E., Asst. Engr., B. & O. Chicago Ter. R. R., Chicago, Ill.
Larsen, Albert, Res. Engr., S. N. E. Ry., Providence, R. I.
Larsen, C. M., Ch. Engr., R. R. Com. of Wis., Madison, Wis.
Lawton, L. C., Div. Eng., A., T. & S. F. Ry., Newton, Kan.
Layng, F. R., Engr. Track, B. & L. E. R. R., Greenville, Pa.
Lee, E. H. Chief Engr., C. & W. I. R. R., Chicago, Ill.
Lee, Frank, Prim. Asst. Engr., Can. Pac. Ry., Winnipeg, Man.
Leffler, B. R., Br. Engr., L. S. & M. S. Ry., Cleveland, O.
Leighty, John R., Engr. of Maint., Mo. Pac. Ry., Kansas City, Mo.
Leisenring, J. G. M., Sig. Engr., Ill. Trac. System, Springfield, Ill.
Lewis, E. R., Asst. to Gen. Man., D. S. S. & A. R. R., Duluth, Minn.
Lindsay, C. E., Div. Engr., N. Y. C. & H. R. R. R., Albany, N. Y.
Lloyd, H. A., Asst. Engr., Erie R. R., Jersey City, N. J.
Long, M. A., Asst. to Ch. Engr., B. & O. R. R., Baltimore, Md.
Mallard, C. C., Supt., Arizona Eastern R. R., Globe, Ariz.
Mann, B. H., Signal Engr., Mo. Pac. Ry. System, St. Louis, Mo.
McBride, J. S., Asst. Engr., C. & E. I. R. R., Salem, Ill.
McCalman, D. S., Div. Engr., K. C. T. Ry., Kansas City, Mo.
McClain, J. B., Res. Eng., S. A. L., Raleigh, N. C.
McComb, R. J., Engr. M. W., W. & L. E. R. R., Canton, Ohio.
McCormick, R. S., Ch. Engr., Algoma C. & H. B. Ry., Sault Ste. Marie, Ont.
McCooe, David, Supt. of Trk., G. T. Ry., Toronto, Ont., Can.
McDonald, Hunter (Past-President), Chief Engr., N., C. & St. L. Ry., Nashville, Tenn.
McGrath, Anthony, Instrumentman, Grand Trunk Ry., Montreal, Can.
McIntyre, L. J., Asst. Engr., Nor. Pac. Ry., St. Paul, Minn.
McNab, William (Past-President), Principal Asst. Engr., Grand Trunk Railway System, Montreal, Canada.
McNeil, J. E., Insp. Tr. and Roadway, Santa Fe Ry., Los Angeles, Cal.
MacFarland, H. B., Engr. of Tests, A. T. & S. F. Ry., Chicago.
MacKenzie, A. C., Engr. M. W., C. P. R., Montreal, Can.
Macomb, J. de N., Jr., Office Engr., A. T. & S. F. Ry., Chicago.
Maney, Thomas, Gen. Roadmaster, L. & N. R. R., Louisville Ky.
Markham, E. L., Asst. Engr., St. L. S. W. Ry., Pine Bluff, Ark.
Merrell, G. W., Asst. to G. M., N. & W. Ry., Roanoke, Va.
Merritt, F., Ch. Engr., G. C. & S. F. Ry., Galveston, Texas.
Millard, Curtiss, Engr., M. W., C., G. W. R. R., Des Moines, Ia.
Mitchell, Geo. A., Supt. B. & B., G. T. Ry., Toronto, Ont., Can.
Mock, J. C., Electrical Engr., Detroit River Tunnel Co., Detroit, Mich.
Montfort, R., Cons. Engr. L. & N. R. R., Louisville, Ky.
Montzheimer, A., Ch. E., E., J. & E. Ry., Joliet, Ill.
Moodie, W. T., Asst. Engr., Can. Nor. Ry., Winnipeg, Man.
Moore, W. H., Engr. Strs., N. Y. N. H. & H. R. R. R., New Haven, Conn.
Morgan, L. T., Civil Engr., Live Oak, Fla.
Morgan, O. K., Office Engr., C. C. & O. Ry., Johnson City, Tenn.
Morphy, L. G., Des. Engr., B. & A. R. R., Boston, Mass.
Morrison, W. W., Engr. M. W., P. S. & N. Ry., Kittanning, Pa.
Morse, C. A. (Director), Ch. Engr., C. R. I. & P. Ry., Chicago.
Morse, W. L., Ch. Engr., Jacksonville Term. Co., Jacksonville, Fla.
Motley, P. B., Engr. Bridges, C. P. R., Montreal, Can.
Mountain, G. A., Ch. Engr. Can. Ry. Commission, Ottawa, Can.
Mullen, Joseph, Engr. M. W., C. C. C. & St. L. Ry., Galion, Ohio.
Nelson, J. C., Engr. M. W., S. A. L., Portsmouth, Va.
Newbegin, P. C., Maint. Engr., B. & A. R. R., Houlton, Me.
Newhouse, C. E., Survey Dept., B. & O. R. R., Baltimore, Md.
Norris, W. H., Bridge Engr., Maine Central Ry., Portland, Me.
Nuelle, J. H., Ch. Engr., N. Y. O. & W. Ry., Middletown, N. Y.
Ogle, W. F., Draftsman, C. R. I. & P. Ry., Chicago, Ill.
Owen, Alfred W., Asst. Engr., Q. & C. Route, Cincinnati, Ohio.
Palmer, G. P., Div. Engr., B. & O. C. T. R. R., Chicago, Ill.
Parker, R. J., Gen. Supt., A. T. & S. F. Ry., Topeka, Kan.
Parker, W. A., Ch. Engr., St. J. & G. I. Ry., St. Joseph, Mo.
Patenall, F. P., Signal Engr., B. & O. R. R., Baltimore, Md.
Patterson, F. M., Dist. Engr., C. B. & Q. R. R., St. Louis, Mo.
Payne, G. W., Asst. Engr., Mo. Pac. Ry., St. Louis, Mo.
Peabody, J. A., Signal Engr., C. & N.-W. Ry., Chicago, Ill.
Pence W. D. (Editor of Publications), Member Engr. Board, Interstate Commerce Commission, Chicago, Ill.
Petersen, W. H., Engr. M. W., C., R. I. & P. Ry., Des Moines, Ia.
Phillips, H. C., Val. Engr., Santa Fe Ry. Sys., Chicago, Ill.
Pickles, J. L., Ch. Engr., D. W. & P. Ry., West Duluth, Minn.
Pifer, C. W., Roadmaster, I. C. R. R., Dubuque, Iowa.
Powell E. W., Consulting Engr., Chicago, Ill.
Power, C. W., Ry. & Br. Engr., Engr. Dept., Toronto, Can.

Ray, G. J., Chief Engr., D., L. & W. R. R., Hoboken, N. J.
Redgrave, W. B., Div. Engr., B. & O. R. R., St. George, S. I., N. Y.
Reid, J. W., Bridge Engr., C. & A. R. R., Chicago, Ill.
Reinholdt, J. H., Prin. Asst. Engr., M. & St. L. R. R., Minneapolis, Minn.
Rex, George E., Manager, Treating Plants, Santa Fe Sys., Topeka, Kan.
Rice, S. B., Engr. M. W., R. F. & P. R. R., Richmond, Va.
Rickert, O., Gen. Roadmaster, Mo. Pac. Ry., Falls City, Neb.
Ridgway, A. O., Asst. Ch. Engr., Denver & Rio Grande R. R., Denver.
Riggs, H. E., Prof. of Civ. Engr., Univ. of Mich., Ann Arbor, Mich.
Roberts, P. B., Office Engr., G. T. R., Montreal, Can.
Roberts, S. S., Consulting Engr., Chicago, Ill.
Robinson, A. F., Bridge Engr., Santa Fe Ry. System, Chicago.
Rohbock, W. L., Ch. Engr., W. & L. E. R. R., Cleveland, Ohio.
Rose, L. S., Engr. in Ch. of Val., Big Four Ry., Cincinnati, O.
Rote, R. O., Jr., Asst. Ch. Engr., L. S. & M. S., Cleveland, O.
Rudd, A. H., Sig. Engr., P. R. R., Philadelphia, Pa.
Rust, T. E., Ch. Engr., W. C. F. & N. Ry., Waterloo, Ia.
Rutledge, R. A., Ch. Engr., E. L., A. T. & S. F. Ry., Topeka, Kan.
Rys, C. F. W., Met. Engr., Car. St. Co., Pittsburg, Pa.
Safford, H. R., Ch. Engr., Grand Trunk Ry. Sys., Montreal, Can.
Sattley, R. C., Asst. Engr., C. R. I. & P. Ry., Chicago, Ill.
Schall, F. E., Bridge Engr., L. V. R. R., So. Bethlehem, Pa.
Schmidt, E. C., Prof. of Ry. Eng., Univ. of Illinois, Urbana, Ill.
Schultz, W. F., Engr., Const., Memphis Un. Sta. Co., Memphis, Tenn.
Schwed, John F., Cleveland, Ohio.
Scott, Guy, Div. Eng., Pa. Lines, Fort Wayne, Ind.
Scribner, G. H., Jr., Contr. Engr., Chicago, Ill.
Selby O. E., Bridge Engr., C., C. C. & St. L. Ry., Cincinnati, O.
Shaver, A. G., Signal Engr., Rock Island Lines, Chicago, Ill.
Shaw, Louis, Civil Engr., La Crosse, Wis.
Shipley, G. B., Con. Eng., Pittsburgh, Pa.
Shurtleff, A. K. (Director), C., R. I. & P. Ry., Chicago.
Simmons, I. L., Bridge Engineer, C. R. I. & P. Ry., Chicago, Ill.
Simons, P. T., Asst. Engr., Mo. Pac. Ry., St. Louis, Mo.
Sisson, F. P., Asst. Engr., Grand Trunk Ry., Detroit, Mich.
Slifer, H. J., Con. Engr., Chicago, Ill.
Smith, A. Bromley, Asst. Engr., C. P. R., Montreal, Can.
Smith, C. E., Asst. Ch. Engr., Mo. Pac. Ry., St. Louis Mo.
Smith, E. V., Div. Engr., B. & O. R. R., Newark, Ohio.
Smith, Huntington, Div. Engr., N. Y. C. & St. L. R. R., Cleveland, O.
Smith, J. E., Instr. C. E., University of Ill., Urbana, Ill.
Smith, W. W., Asst. Engr., G. T. Ry., Montreal, Canada.
Snow, J. P., Con. Engr., Boston, Mass.
Sparrow, L. L., Engr. Roadway, A. C. L., Jacksonville, Fla.
Sparrow, W. W. K., Jefferson City, Mo.
Sprague, Willson, Div. Engr., N. Y., C. & St. L. R. R., Conneaut, O.
Stark, C. W., Assoc. Editor, Engineering Record, New York.
Spencer, W. T., Div. Engr., N. Y. N. H. & H. R. R., Waterbury, Conn.
Stein, C. H., Supt., C. R. R. of N. J., Jersey City, N. J.
Sterling E. A., Con. Forester, Philadelphia, Pa.
Sterling, Paul, Div. Engr., N. Y. N. H. & H. R. R., Hartford, Conn.
Stern, I. F., Con. Engr., Chicago, Ill.
Stevens, F. S., Engr. M. W., P. & R. Ry., Reading, Pa.
Storey, W. B. (First Vice-President), Vice-President, Santa Fe System, Chicago, Ill.
Strouse, W. F., Asst. Engr., B. & O. R. R., Baltimore, Md.
Stuart, H. B., Struct. Engr., Grand Trunk Ry., Montreal, Can.
Sullivan, John G. (Director), Ch. Engr. Western Lines, C. P. Ry., Winnipeg, Canada.
Swartz, Albert, Engr. M. W., Toledo Rys. Co., Toledo, Ohio.
Talbot, A. N., Prof. Mun. & San. Engr., U. of Ill., Urbana, Ill.
Taussig, J. E., Supt. Trans., T. & P. Ry., Dallas, Tex.
Taylor, E. B., Jr., Div. Engr., Penna. Lines, Allegheny, Pa.
Teal, J. E., Asst. Engr., B. & O. R. R., Baltimore, Md.
Tebbetts, G. E., Br. Engr., Kansas City Terminal Ry., Kansas City, Mo.
Temple, E. B., Asst. Ch. Engr., Pennsylvania R. R., Philadelphia, Pa.
Thompson, A. W., Third Vice-Pres., B. & O. R. R., Baltimore, Md.
Thompson, F. L., Eng. Const., I. C. R. R., Chicago, Ill.
Tinker, G. H., Br. Engr., N. Y. C. & St. L. Ry., Cleveland, O.
Tordella, J., Div. Engr., B. & O. R. R., Garrett, Ind.
Townsend, T. G., Tim. Treat. Insp., Sou. Ry., Washington, D. C.
Tratman, E. E. R., Resident Editor, Engineering News, Chicago, Ill.
Trench, W. I., Div. Eng., B. & O. R. R., Baltimore, Md.
Trenholm, J. B., Asst. to Ch. Engr., A. C. Line R. R., Wilmington, N. C.
Trimble, Robert (Second Vice-President), Ch. Engr. M. W., N. W. Sys. Penna Lines, Pittsburgh, Pa.
Trumbull, M. K., Vice-Pres., Natl. Lumber & Creo. Co., Texarkana, Tex.
Turneaure, F. E., Dean, Col. of Engr., Univ. of Wis., Madison, Wis.
Underwood, B. A., Res. Engr., S. N. E. R. R., Webster, Mass.
Unger, J. S., Man. Research Lab., Carnegie Steel Co., Duquesne, Pa.
Van Auken, A. M., Insp. M. of W., C. R. I. & P. Ry., Shawnee, Okla.
Van Auken, K. L., Editor, Ry. Eng. and M. W., Chicago, Ill.
Van Hagan, L. F., Asso. Prof., U. of Wis., Madison, Wis.
Von Schrenk, Herman, Dr., Con. Timber Engr., St. L. & S. F. R. R. and New York Cent. Lines, St. Louis, Mo.
Walker, I. O., Asst. Engr., N. C. & St. L. Ry., Paducah, Ky.
Wallace, W. A., Chicago, Ill.
Walling, V. R., Prin. Asst. Engr., C. & W. I. R. R., Chicago, Ill.
Waring, O. T., Supt., A. C. L. R. R., Waycross, Ga.
Warren, W. D., Div. Engr., C. N. E. Ry., Hartford, Conn.
Weatherly, E. P., Engr. M. W., K. C. T. Ry., Kansas City, Mo.
Webb, Walter Loring, Public Utility Engr., Philadelphia, Pa.
Weir, John M., Asst. Engr., C. R. I. & P. Ry., Chicago, Ill.
Wendt, Edwin F. (President), Member Engr. Board, Interstate Commerce Commission, Washington, D. C.
Whitney, T. B., Jr., Engr. Design, H. & M. R. R., New York.
Wickhorst, M. H., Engr. of Tests, Rail Committee, Chicago, Ill.
Wiggins, W. D., Val. Engr., Pa. Lines, West Pittsburgh, Pa.
Wilgus H. S., Engr. M. of W., P. S. & N. R. R., Angelica, N. Y.
Williams, S. N., Prof. C. E., Cornell College, Mt. Vernon, Iowa.
Willoughby, J. E., Asst. Ch. Engr., A. C. L., Wilmington, N. C.
Wilson, C. A., Consulting Engr., Cincinnati, O.
Wiltsee, W. P., Asst. Engr., N. & W. Ry., Norfolk, Va.
Wishart, J. G., Ch. Draftsman, C., R. I. & P. Ry., Chicago, Ill.
Wood, B. A., Ch. Engr., M. & O. R. R., Mobile, Ala.
Woods, H. A., Asst. Ch. Engr., Gr. Tr. Pac. Ry., Montreal.
Yager, Louis, Div. Engr., Northern Pacific Ry., St. Paul, Minn.
Yates, J. J., Bridge Engr., Cent. R. R. of N. J., New York, N. Y
Zook, M. A., I. C. C., Div. of Val., Washington, D. C.

GUESTS.

Albers, J. L., N. C. & St. L. R. R., Nashville, Tenn.
Atkinson, L. H., Bethlehem Steel Co., South Bethlehem, Pa.
Austin, F. S., Supt. Track, B. & A. R. R., Worcester, Mass.
Bagnell, E. C., Asst. Engr., S. A. L. Ry., Norfolk, Va.
Baldridge C. W., Asst. Engr., A. T. & S. F. System, Chicago, Ill.
Bellamy, B. C., P. K. & G. Ry., Laramie, Wyo.
Bellin, W. C., Asst. Div. Engr., B. & O. C. I. R. R., Chicago, Ill.
Bidwell, J. N., Sig Engr., Wis. R. R. Comm., Madison, Wis.
Blanchard, A. M., Instrumentman, South Bridge, Mass.
Bond, F. L. C., Div. Engr., Grand Trunk Ry., Montreal, Can.
Bricker, H. R., Inspr., B. & O. R. R., Baltimore, Md.
Buckalew, S. J., Div. Engr., St. L. S. W. Ry., Tyler, Tex.
Burnett, J. A., Electrical Engr., Grand Trunk Ry., Montreal, Can.
Cahill, Eugene, Gen. For., D. L. & W. R. R., Scranton, Pa.
Clough, A. W., N. Y. C. Lines, Balacka, N. Y.
Cone, Albert, American Lumberman, Chicago, Ill.
Cousins, E. L., C. E., Toronto Harbor Comm., Toronto, Can.
Colligan, A. F., Asst. Div. Engr., D. L. & W. R. R., Scranton, Pa.
Crombie, J. C., Supt., Grand Trunk Ry., St. Thomas, Can.
Dillon, Sydney, C. E., Carnegie Steel Co., Braddock, Pa.
Dubray, Arthur B., S. E., Public Service Comm. of Mo., Jefferson City, Mo.
Earls, J. L., Bridge Supr., N. C. & St. L. R. R., Tallahoma, Tenn.
Elenore, J. T., Div. Engr., S. A. L. Ry., Richmond, Va.
Ellsworth, F. H., N. Y. N. H. & H. R. R., New Haven, Conn.
Ems, H. L., Chief Clerk, C. & A. R. R., Chicago, Ill.
Fulweiler, W. H., Philadelphia, Pa.
Farrell, W. H., Supt., Grand Trunk Ry., Toronto, Canada.
Foard, J. W., Secretary to E. M. of W., B. & O. R. R., Baltimore, Md.
Foote, J. W., Div. Engr., Erie R. R., Salamanca, N. Y.
Gannet, C. W., Jr., Engr., Robt. W. Hunt & Co., Chicago, Ill.
Gent, J. B., Asst. Engr., Grand Trunk Ry., Montreal, Can.
Gifford, G. D., Supt. Track, N. Y. C. & H. R. R. R., Rochester, N. Y.
Gooding, W. J., Div. Engr., S. A. L. Ry., Jacksonville, Fla.
Goltra, W. F., President, The W. F. Goltra Tie Co., Cleveland, Ohio.
Grills, A., Gen. R. M., Grand Trunk Ry., St. Thomas, Canada.
Griswold, W. W., P. A. W. & L. E. R. R., Cleveland, Ohio.

Haise, C. C., Asst. Engr., Ill. Central R. R., Chicago, Ill.
Hammond, C. P., Engr. M. of W., C. of Ga. R. R., Savannah, Ga.
Hardman, Wm., Gen. For., D. L. & W. R. R., Binghamton, N. Y.
Hargrave, F. W., Canadian Northern Ry., Winnipeg, Man.
Harlan, R. J., Central of Ga. R. R., Macon, Ga.
Harrop J. L., Jefferson City, Mo.
Haupt, E., Strobel Steel Constr. Co., Chicago, Ill.
Hood, J. C., Supt. B. & B., Nor. Pac. R. R., Duluth, Minn.
Howe, Woodbury, Locating Engr., A. T. & S. F. Ry., Chicago, Ill.
Harrison, E. A., Architect, A. T. & S. F. Ry., Chicago, Ill.
Hesterly, W. S., Roadmaster, M. L. & T. R. R., Morgan City, La.
Hett, Jno., Roadmaster, H. & T. C. Ry., Hempstead, Tex.
Hunter, J. W., Div. Engr., C. & E. I. R. R., Salem, Ill.
Jackson, A. A., Asst. Engr., B. & O. R. R., Baltimore, Md.
Jackson, Wm. B., D. C. & Wm. B. Jackson, Engineers, Chicago, Ill.
Johnson, C. H., Engr. of Constr., N. Y. C. & St. L. Ry., Nashville, Tenn.
Johnson, J. T., Genl. Supt., Central of Ga. Ry., Savannah, Ga.
Johnston, J. H., Supt. of B. & B., Grand Trunk Ry., Montreal, Can.
Keitsinger, W. K., Seattle, Wash.
Kenyon, G. M., St. Paul, Minn.
Klumpp, C. S., Supt. M. W. & S., N. Y. C. & H. R. R. R., New York, N. Y.
Klumpp, G. J., Supr. of Bridges, N. Y. C. & H. R. R. R., Rochester, N. Y.
Laden, P., Inspr. Grand Trunk Ry., Rockford, Canada.
Lamoraux, D. P., Chicago, Ill.
Lants, H. B., Asst. to Gen. Mgr., A. T. & S. F. Ry., Topeka, Kan.
Larson, C. M., R. R. Commission of Wis., Madison, Wis.
Leon, A. L., Transitman, G. T. Ry., Montreal, Can.
Lynch, P. J., Supt. Grand Trunk Ry., Allandale, Ont.
Lyons, P. F., Western Agent National India Rubber Co., Chicago, Ill.
Mackrell, Theo., Supt., Erie R. R., Huntington, Ind.
Machemer, H. W., Asst. Engr., D. L. & W. R. R., Buffalo, N. Y.
Madden, M. M., Draftsman, A. T. & S. F. Ry., Chicago, Ill.
McDaniel, A. B., Asst. Prof. C. E., University of Illinois, Urbana, Ill.
McKey, D. M., Locating Engr., S. A. L. Ry., Plant City, Fla.
McQueen, A., D. L. & W. R. R., Scranton, Pa.
Moore, DeWitt, Dist. Engr., I. C. C., Chicago, Ill.
Moorshead, O., Cons. Engr., Newton, Kan.
Morgan, H. H., Robt. W. Hunt & Co., Chicago, Ill.
Moursiued, E. M., H. & T. C. R. R., Texas.
Munsell, A. W., Mich. Cent R. R., Detroit, Mich.
Neurentor, H. M., D. L. & W. R. R., Scranton, Pa.
North, N. P., Div. Agent, Chicago, Ill.
Parry, Wm. I., Salesman, Pittsburgh, Pa.
Pettis, W. A., Genl. Supr. Bldgs., N. Y. C. & H. R. R. R., Rochester, N. Y.
Phillips, S. B., Asst. Engr., O.-W. R. R. & N. Co., Seattle, Wash.
Pomeroy, L. S., Civil Engr., St. Paul, Minn.
Potts, F. A., Asst. Engr., Wis. R. R. Commission, Milwaukee, Wis.
Ramsey, M. A., Supt. Cent. of Ga. Ry., Macon, Ga.
Ridsdale, P. S., American Forestry Commission, Washington, D. C.
Ryer, F. A., Pa. B. & A. R. R., Boston, Mass.
Schofield, J., Architect, Canadian Nor. Ry., Winnipeg, Man.
Schwartz, H. C., Master Carpenter, Grand Trunk Ry., St. Thomas, Ont.
Sessions, O. H., Asst Engr., Grand Trunk Ry., Battle Creek, Mich.
Shipley, L. B., Chemist, Barrett Mfg. Co., New York City.
Skelton, W. N., N. Y. C. & H. R. R. R., Utica, N. Y.
Sparks, E. R., B. & O. R. R., Baltimore, Md.
Spath, C. E., Chief Clerk, N. Y. C. & St. L. R. R., Cleveland, O.
Spieth, O. C., Asst. Div. Engr., B. & O. R. R., Cleveland, O.
Stansbury, H E., E. P. & S. W. R. R., Tucumcari, N. M.
Stewart, J. N., Asst. Engr., A. T. & S. F. Ry., Dodge City, Kan.
Stiff, Wm. N., Water Service Foreman, D. L. & W. R. R., Scranton, Pa.
Strachan, G. M., A. T. & S. F. Ry., Chicago, Ill.
Stradling, David W., Assoc. Editor, Engr. & Contr., Chicago, Illl.
Taylor, C. E., Mich. Cent. R. R., Detroit, Mich.
Thorp, J. N., Jr., Engr. of Tests, Erie R. R., Jersey City, N. J.
Triplett, A. E., Asst. Supt. M. of W., G. H. & S. A.—Sunset Line, Victoria, Tex.
Walbridge, Jno. T., Consulting Engr., Chicago, Ill.
Winship, L., Asst. Engr., Mo. Pac. Ry., St. Louis, Mo.
Young, J. B., Chemist, P. & R. Ry., Reading, Pa.
Young, D. R., Asst. Engr., D. L. & W. R. R., Buffalo, N. Y.

A LOVING CUP FOR JOHN N. REYNOLDS

In announcing the resignation of John N. Reynolds as treasurer of the National Railway Appliances Association, at its annual meeting yesterday, President Wyles commented on the long and faithful performance of his duties, not alone in this Association, but in the various other railway appliances associations with which he has been connected. He then introduced J. Alexander Brown, who, in behalf of the directors of the Association, presented Mr. Reynolds with a handsome loving cup. Mr. Brown said:

"It has been a great pleasure for me to be appointed by the directors of this Association to present with their compliments this loving cup, as a slight appreciation of Mr. Reynolds' long and faithful work, first as secretary and treasurer, and later as treasurer. We hope he will have many years of life and pleasure, and will often fill this cup and drink to old memories."

Mr. Reynolds was elected secretary and treasurer in 1902, when the organization was known as the Road and Track Supply Association. It had charge of the exhibits at both the Railway Engineering and Maintenance of Way Association conventions, which met in March, and the Roadmasters' Association, which met in September, thus requiring two exhibitions a year. To the secretary and treasurer, who was also director of the exhibits, this meant much arduous and hard work. In 1902, and for several years thereafter, the exhibitions were held in the parlors of the Auditorium. The space available for exhibits was more than ample during the earlier years, but gradually it filled up and became inadequate.

Five years ago, and while Mr. Reynolds was still secretary and treasurer, it became necessary to remove the exhibits to the Coliseum. That place was soon outgrown, and for the past three years it has been necessary to use the First Regiment Armory as well. Because of the great amount of work and responsibility involved in the two positions it was decided in 1911 to separate the offices of secretary and treasurer, and Mr. Reynolds was elected treasurer, which position he has held since that time.

Bruce V. Crandall, the present secretary, in commenting on Mr. Reynolds' retirement, yesterday said: "It is hardly necessary to make any comment—everyone knows 'Uncle John.' His loyalty, not only to this association, but to all of the various railway appliances associations, is known to every man who belongs to the railway fraternity. When a soldier retires from service a fitting climax seems to be an honorable discharge and some recognition for years of loyalty and devotion. He is entitled to this small recognition and to the relief from active service. If we have a veteran in our association it is certainly 'Uncle' John Reynolds; he is entitled to an honorable discharge, and he has earned the opportunity to shoulder onto younger men the duties and responsibilities which he has carried. With Mr. Reynolds' retirement from active participation in the affairs of the National Railway Appliances Association, there goes from each member of the organization a wish that he may have what every veteran should have—many years in which to enjoy in retrospect the busier days which have gone and the quieter ones which are to come."

WOOD PRESERVERS' DINNER AT ENGINEERS' CLUB

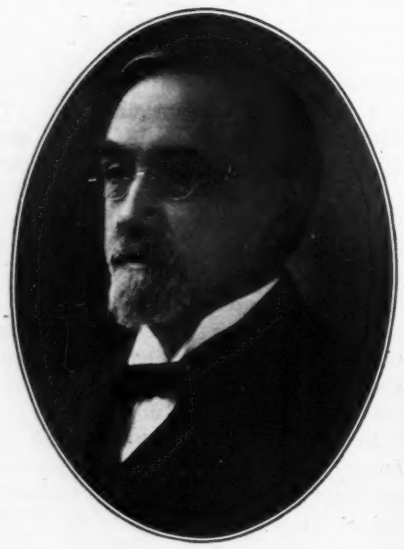
President Rex and the officers of the Wood Preservers' Association inaugurated a new practice in that organization when they arranged for 30 officers and committee members to meet at dinner at the Chicago Engineers' Club last evening. Representatives of the various committees of that association outlined their phases for work for the coming year, which were thoroughly discussed. The interest and enthusiasm evident indicates a successful year.

A. S. M. E. TO DISCUSS STEAM POWER PLANTS

On Wednesday evening the American Society of Mechanical Engineers, Chicago Section, will hold a dinner and meeting at the Sherman House. The subject of the evening is "Large Steam Power Plants." There will be present at the meeting the men in responsible charge of several of the largest steam power plants in America, who will speak briefly and informally on various stages of the subject. The speakers will be John F. Sparrow, New York Edison Company, New York City; I. E. Moultrop, Edison Electric Illuminating Company, Boston; Jas. B. Andrew, Edison Electric Illuminating Company, Boston; J. W. Parker, Detroit Edison Company, Detroit, Mich.; John Hunter, Union Electric Light & Power Company, St. Louis; W. L. Abbott, Commonwealth Edison Company, Chicago.

RECEPTION AND DINNER FOR IRA O. BAKER

The completion of 40 years of service on the engineering faculty of the University of Illinois by Professor Ira Osborn Baker, was made the occasion for a reception and dinner in his honor yesterday afternoon and evening at the Hotel La Salle. While the plan was originated and arrangements carried out by a committee of alumni of the university, the company attending the reception and dinner was not composed solely of alumni, and included many of the best known men in the engineering profession in this country. The date was fixed with the intention of offering an opportunity to all railway men in attendance at the A. R. E. A. convention to attend, and a large number of them took advantage of the opportunity.



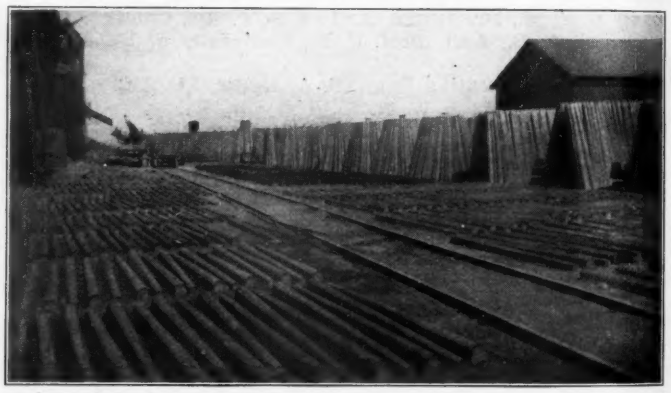
PROF. IRA O. BAKER.

Professor Baker has made himself well known among engineers by his books and other technical writing and the active part which he has taken in the work of technical associations and societies. He is the author of treatises on Masonry Construction, Leveling, Durability of Brick Pavement, Engineers' Surveying Instruments and various articles in engineering papers and the proceedings of societies. He is a member of the American Society of Civil Engineers, the Western Society of Engineers, the Society for the Promotion of Engineering Education and the Illinois Society of Engineers. Practically his entire life has been spent in the service of the University of Illinois. Graduating from that institution at the age of 21, he immediately became an assistant in civil engineering and physics; four years later he was made instructor in civil engineering, the next year assistant professor and the next year professor, the position he has filled ever since.

The toastmaster at the dinner was William D. Pence, member of the Engineering Board of the Interstate Commerce Commission, who is an Illinois graduate. The life and work of Professor Baker as a teacher, an engineer, and a man were sketched at some length by Clarence H. Blackall, who graduated at Illinois only three years after the professor, and has always been his intimate friend. Greetings were presented by Hunter McDonald, president of the American Society of Civil Engineers; Edward H. Lee, president of the Western Society of Engineers; Professor Henry S. Jacoby, vice-president of the Society for the Promotion of Engineering Education; John J. Harman, president of the Illinois Society of Engineers; Edmund J. James, president of the University of Illinois; Edwin F. Wendt, president of the American Railway Engineering Association; Arthur N. Talbot, president of the American Society for Testing Materials, and Lincoln Bush and Warren R. Roberts, representing the Civil Engineering Alumni of the University of Illinois. Professor Baker responded briefly to these greetings.

MAKING CONCRETE FENCE POSTS ECONOMICALLY

The San Pedro, Los Angeles & Salt Lake is using a very economical plant for the manufacture of concrete fence posts at Lynndyl, Utah, which is an important improvement over the dry mix method requiring tamping. The plant utilizes an idle coal chute to secure a gravity handling of the material. The gravel is received in dump cars, which are run up the incline over the bins built in the trestle work. The gravel is dumped into these bins, from the bottom of which a trough leads down to the mixer. The aggregate is measured in this trough by the use of gates placed at intervals for various quantities. By lifting the gates in the end of the trough, the gravel drops directly into the feed chute over the mixer. The mixer, which is of the batch type, is mounted upon a raised platform, and, as the gravel is dumped, the proper amount of cement, and later the water, are applied, the mixture being made of the consistency of wall plastering, which has been found to give the best results.



General View of Salt Lake Line Concrete Post Plant.

The post equipment furnished by the D. & A. Post Mold Company, Three Rivers, Mich., was selected for this plant. A 10-mold machine, with a large number of extra molds, andchor and brace molds, are provided. The mold bed is mounted on trucks, which are run under the discharge chute of the mixer, with the molds in position for filling. When sufficient concrete has been dumped to fill the 10 molds level full, the concrete is leveled off and compacted by the shaking system. Hoop steel reinforcement of No. 18-gage 5/8-in. metal is used in these posts. When the filled molds are ready to be removed from the frame other molds replace them, and the filling operation is repeated. The concrete is allowed to set for 24 hours before the posts are removed and set on end or laid upon soft level ground. They are allowed to season for about 60 days before placing. The economical methods used at this plant make it possible to produce concrete fence posts at a cost comparing very favorably with wooden posts.

NEW CONSTRUCTION PROPOSED

The Janesville & Madison Traction will let contracts before September for 50 miles of line from Beloit, Wis., to Madison.

CANADIAN PACIFIC CONSIDERING ELECTRIFICATION

Westinghouse, Church, Kerr & Co. have been retained by the Canadian Pacific to investigate the proposed electrification of the Selkirk tunnel in British Columbia, 5½ miles long.

LUNCHEON OF COMMITTEE NO. 10

Committee No. 10, on Signals and Interlocking, had luncheon together Tuesday noon. These luncheons are becoming an annual affair with this committee, which has remained practically intact for several years.

TELEPHONES AT THE COLISEUM

Call Calumet 3800 to reach the secretary of the National Railway Appliance Association, or any of the exhibitors at the Coliseum or the Armory.

PENNSYLVANIA LINES' DIVISION ENGINEERS' ASSOCIATION

The Pennsylvania Lines' Engineers' Association is holding its semi-annual meeting Tuesday and Wednesday at the Karpen building. About 35 members are in attendance.

CHANGES ON THE NICKEL PLATE

W. F. Watterson, superintendent of the New York, Chicago & St. Louis, at Buffalo, N. Y., has been transferred to Ft. Wayne, Ind., and E. J. Parish succeeds Mr. Watterson.

CORNELL MEN AT BANQUET

Two tables have been reserved for Cornell men at the banquet to-morrow evening. Tickets can be secured at the regular place in the secretary's office or from H. C. Holloway or C. W. Gennet.

MEETING OF COMMITTEE ON STRESSES IN TRACK

The recently appointed committee on Stresses in Track will meet to-day at 12 o'clock in the Francis the First room of the Congress hotel. The chairman, Professor Talbot, desires a full attendance of the committee.

PRESIDENT OF M. C. B. ASSOCIATION HERE

M. K. Barnum, president of the Master Car Builders' Association and general mechanical inspector of the Baltimore & Ohio, spent yesterday attending the meetings of the A. R. E. A. and visiting the exhibits at the Coliseum. The M. C. B. Committee reports are coming in much earlier than usual this year and the indications are for a more than ordinarily successful convention next June.

UNIVERSITY OF PENNSYLVANIA ALUMNI REUNION

Over a dozen alumni of the University of Pennsylvania will meet at lunch Wednesday noon. The party will include J. E. Crawford, chief engineer, Norfolk & Western; William McGonagle, president, Duluth, Missable & Northern; C. E. Lindsay, division engineer, New York Central & Hudson River; J. B. Austin, Jr., division superintendent, Long Island; J. C. Irwin, Boston & Albany; A. B. Cuthbert, principal assistant engineer, Pennsylvania Railroad; O. T. Waring, division superintendent, Atlantic Coast Line; H. F. Sharpley, Jr., Central of Georgia; O. J. West, consulting engineer, Chicago; O. P. Chamberlain, chief engineer, Chicago & Illinois Western; J. R. Savage, chief engineer, Long Island Railroad; H. Bortin, secretary, Valuation Board Interstate Commerce Commission; E. F. Kenney, Cambria Steel Company; P. H. Wilson and R. S. Coombs.

W. S. MURRAY BECOMES CONSULTING ENGINEER OF NEW HAVEN

W. S. Murray has been appointed consulting engineer of the New York, New Haven & Hartford, at New Haven, Conn. Mr. Murray was formerly electrical engineer of this road, in charge of electrification from New York to Stamford, and more recently from Stamford to New Haven, resigning to enter private practice in partnership with E. H. McHenry, on May 1, 1913.

CHANGE IN FIRM NAME

The Des Moines Bridge & Iron Company announces that since February 1 its business has been handled under two firm names. Contracts west of the Mississippi River have been made by the Des Moines Bridge & Iron Company, Des Moines, Ia., and those east of that line by the Pittsburgh-Des Moines Steel Company, Pittsburgh, Pa. Both companies are under the same management as the old Des Moines Bridge & Iron Company, of Pittsburgh and Des Moines.

ARMOUR INSTITUTE STUDENTS AT THE CONVENTION

In order to make it possible for the students in the civil engineering department at the Armour Institute of Technology to attend the sessions of the A. R. E. A. convention and the track supply exhibit, all classes in sophomore, junior and senior studies are dismissed Tuesday, Wednesday and Thursday afternoons. These students are urged to attend the convention and exhibit, and are furnished tickets to the latter. About 40 of the boys were in attendance at the convention at some time during the Tuesday sessions, and the remainder of the 100 students in this department will come to some of the later sessions.

C. G. DELO NEW CHIEF ENGINEER OF THE GREAT WESTERN

Charles G. Delo, engineer maintenance of way of the Chicago Great Western at Chicago, has been appointed chief engineer, succeeding L. C. Fritch, effective at once. Mr. Delo has been in railway service since 1887, when he commenced as rodman with a bridge corps on the Atchison, Topeka & Santa Fe. From April, 1890, to July, 1902, he was with the Burlington, Cedar Rapids & Northern, consecutively as assistant engineer, draftsman and divison engineer. He then went to the Chicago, Rock Island & Pacific as principal assistant engineer, resigning in November of the following year to engage in contracting business. Mr. Delo re-entered active railway service in March, 1904, as division engineer of the Chicago Great Western. From July, 1905, to September, 1908, he was engineer maintenance of way of the Chicago & Alton, returning to the Chicago Great Western on the latter date, where he remained three months as division engineer at Des Moines, Ia. He then became engineer maintenance of way of the National Railways of Mexico, resigning in

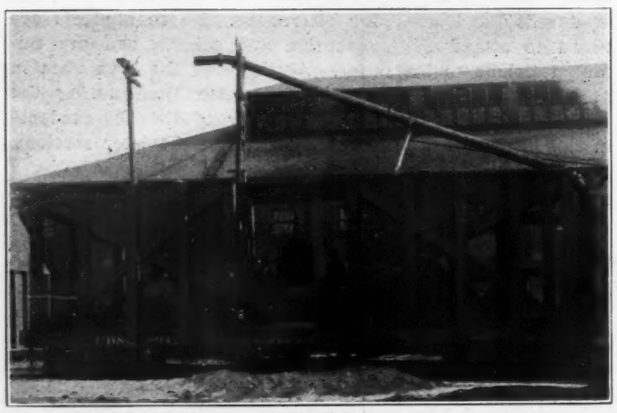
March, 1910, to return again to the Chicago Great Western as engineer maintenance of way.

A NEW COPYING PROCESS

A new process for making high-grade photographic reproductions quickly and at a low cost from blue prints, tracings or any black and white copy is being used by the American Blue Print Paper Co., Chicago. Prints up to 11 in. by 14 in. are made on a sensitized parchment from any size of original copy. No negative is made, eliminating considerable time necessary to develop, fix, wash and dry a negative before printing and enabling work to be completed in two or three hours. The finished prints can be folded without cracking and subjected to other hard usage without serious damage. They can also be used as negatives in making blue print, blue line and black line prints at small cost. Engineers and architects are beginning to make use of such photographic reproductions of large tracings or blue prints in a size easy to handle and yet durable and permanent. The process is also valuable in copying important papers or records.

MIXING AND DISTRIBUTING CONCRETE BY COMPRESSED AIR

A radical departure in mixing and placing concrete has been made in the MacMichael pneumatic mixer and conveyor, which utilizes compressed air for mixing the ingredients and for forcing the concrete through a pipe to place in the forms. This system has been used in a number of cases with good results. The mixer consists of a conical drum with an elbow at the bottom to which the conveyor pipe is attached and with a hopper at the top which is closed by a door operated by an air piston. The cement, sand, stone and water are fed into the mixer through the hopper and the door is closed. The air is then turned on, entering the mixer at two points, one above the charge, and one at the heel of the elbow. The 80-lb pressure which is used mixes the materials and

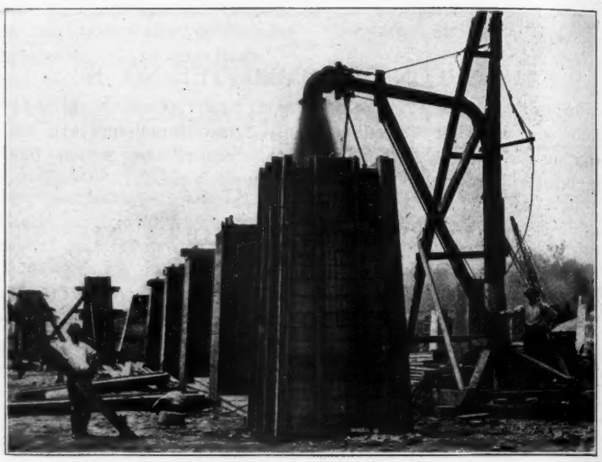


Tunnel-Lining Car Using MacMichael Pneumatic Mixer.

blows the mixed concrete out through the bottom of the cone and through the pipe to the forms

The output of the machine is dependent upon the speed of loading. The mixers are made in ¼ and ½-yd. sizes and the speed of loading varies between 60 and 120 batches per hour. The provision of overhead bins makes possible the higher rate of loading which would give the ¼-yd. machine a capacity of 30 yds. per hour, and the ½-yd. machine 60 yds. An 8-in. pipe of No. 10 gage metal or an 8-in. well casing is used for conveying the concrete. The facility with which the delivery pipe can be carried under, over, or around obstructions which would make wheeling difficult, is one of the important advantages of the system.

The pneumatic method has been used to advantage in bridge construction, as it is not required that the mixer be located above the point of deposit as is usually the case with plants distributing by gravity systems. The machine is well adapted to tunnel lining as it enables the arch to be placed as rapidly as the sidewalls, and it has been used with success in retaining wall work by



Placing Concrete in Piers at Otis Steel Company Plant, Cleveland, O.

carrying the pipe over the top of the forms and using a 90-deg. elbow to direct the concrete down into the forms. Piers and heavy foundation work have also been handled at a considerable saving in cost over the old method. Whenever it is desirable, a box may be used to receive the concrete as it is discharged from the pipe, from which it can be allowed to run out by gravity into the forms.

The air required to operate the plant varies according to the distance from the mixer to the forms, the number of elbows in the line, etc. A convenient method for estimating the required capacity of the air plant is to assume one cubic foot of free air compressed to 80-lb. pressure for each lineal foot of pipe per batch of concrete. For general concreting work a compressor of 600 cu. ft. per minute capacity is probably the best size, although a 300 cu. ft. machine would be large enough to use with a ¼-yd. mixer and 300 ft. of pipe.

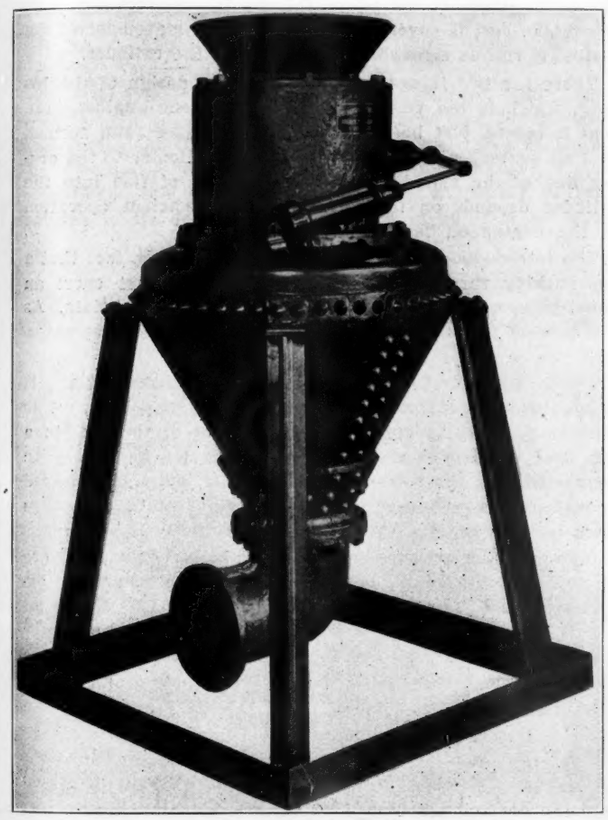
Clogging of the pipe may occur when stones of too large size are used. It has been found that the limit in size for successful operation is about two inches. Where crusher-run stone is used with this machine, as it has been on three jobs, a large rock occasionally gets in an elbow and plugs it. In some cases this can be loosened by tapping the pipe while the pressure is on, but if the rock is too large or too tightly wedged it is necessary to remove the pipe and punch out the obstruction. No clogging occurs, however, when the proper size of stone is used, providing the machine is not operated with an air pressure very much below the 80 lbs. required for successfully carrying the concrete to the full distance. An air storage tank is usually placed close to the machine, the capacity of this tank being large enough to store sufficient air at 80 lbs. pressure to discharge one load, which means one cubic foot of space for each six feet of pipe line.

The Otis Steel Co. used a ¼-yd. machine at Cleveland, O., for placing the piers for its new plant. The piers range in height from 12 to 18 ft. above the ground, and

each contains from 10 to 19 yds. of concrete. The machine is located under bins which are kept filled by clam shell buckets operated by locomotive cranes, the distribution pipe having a total length of 500 ft. The air is furnished by an Ingersoll-Rand motor-driven air compressor of 500 ft. per minute capacity and the plant is operated by about eight men. The following statement of cost covers one week's run, during which 725 cu. yds. were placed.

Unloading material by locomotive crane...	$0.08 per cu. yd.
Entire labor cost of mixing, conveying and placing 300 ft. from machine.....	0.27 per cu. yd.
Cost of air, including labor and power....	0.085 per cu. yd.
Total	$0.435 per cu. yd.

The Ontario Power Co., Niagara Falls, Ont., placed three concrete walls by this method in September, 1913, at a



The MacMichael Pneumatic Concrete Mixer.

considerable saving. One wall was 20 ft. below the elevation of the mixer and about 100 ft. west, the other two walls being at an elevation 30 ft. above the mixer and 80 ft. east. The plant required one foreman and 10 laborers to charge the mixer; three men to operate it and one foreman and four men to spread the concrete in the forms. During the time required to change the pipe, the charging gang was use in excavating, so that a portion of their time was not chargeable to the cost of placing the concrete. The labor cost per hour was $4.80, and, charging the actual time used in placing 257 yds., the cost amounted to $77.35, or $0.30 per cubic yard.

A tunnel lining car has just been built by the Chicago, Burlington & Quincy, which will be used first at Bonneville, Wyo., on the Thermopylis-Orin Junction extension. The mixer and conveyor is mounted on a standard 40-ft. flat car, carrying also bins with a capacity of 705 cu. ft. for the aggregate, which will consist of bank run gravel. These bins slope to the center of the car and discharge through chutes into a measuring hopper. The cement is stored in bags under one of the bins, which is 18 in. narrower than the car, to leave space for a man to carry cement bags from under the bin up a slight incline to the mixer platform.

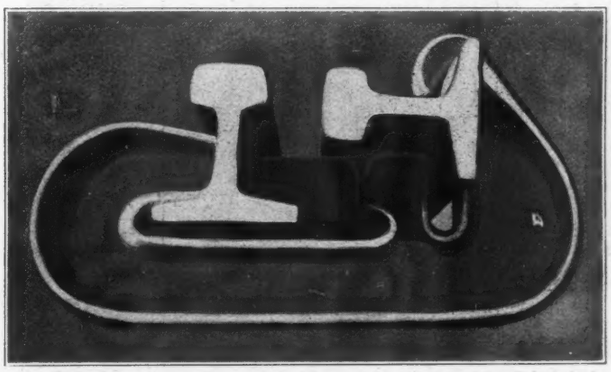
The measuring hopper is lifted and tilted to discharge into the mixer by a cable operated by a small air cylinder. The pipe which conveys the concrete from the mixer to the tunnel forms is 8 in. in diameter, and runs from the mixer under the car and up at the end to the top of the bins which are 14 ft. above the rail, and then on an incline above the car to a point about 24 ft. above the rail, where it enters through a bulkhead in the tunnel form. This inclined pipe is raised and lowered in order to clear the braces of the tunnel forms which require about 16 ft. of clearance. This pipe is raised and lowered between guides by a cable attached to an air cylinder. When the pipe is lowered to its resting point on top of the bins the guides fold down and are out of the way.

The car is run into the tunnel with enough material for about 25 cu. yds. of concrete and is connected to an air supply line laid along the track at whatever point the work is to be carried on. It may be unloaded in one hour, mixing conveying and placing 25 yds. of concrete in tunnel forms with a crew of four men. The crew consists of one man who operates the mixer and all he valves, one to carry cement, one to untie the cement sacks and dump the cement into the hopper, and one to operate the gates for filling the measuring hopper with aggregate.

These machines are not being sold, but are leased by the Concrete Mixing & Placing Co., Chicago.

A NEW TYPE OF GUARD RAIL CLAMP

A new guard rail clamp has just been developed by the Q. & C. Company, New York, which is particularly adapted to guard rails not over 10 ft. long. Its special feature is that the guard rail is laid down on its side, which eliminates the loss of strength due to the machining



New Guard Rail Clamp.

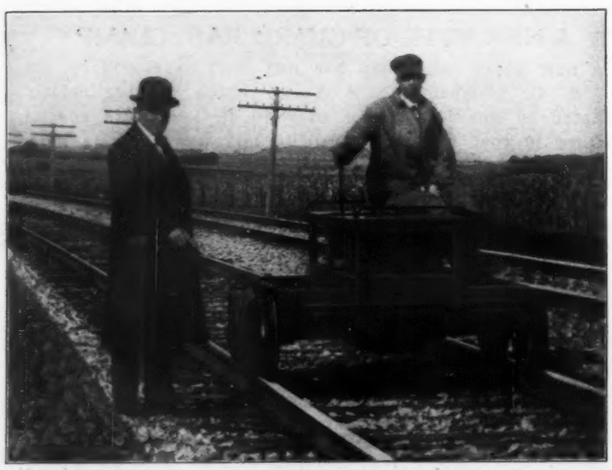
of the base which is necessary in all perpendicular guard rails. The clamp consists of two parts, a cast steel yoke and a malleable iron filler wedge. The yoke is first affixed to the main rail and is held fast in this position by driving the wedge between the rails and the upright lug in the yoke. The wedge is held in place by cotter pins dropped into holes drilled on the shelf of the wedge. The guard rail is then slipped in from the end of the clamp and is held down by the hook end of the yoke. In this position it offers the greatest resistance to side thrust and with two clamps on a 10 ft. guard rail there is scarcely any possibility of spreading the flangeway.

NICKEL CHROME STEEL FROG AND CROSSING BOLTS

In common with other manufacturers of hard center track work, the Pennsylvania Steel Company, Steelton, Pa., has realized that the use of ordinary carbon steel bolts tends to decrease the life of such track work and they have therefore developed the Mayari nickel chrome heat treated steel bolts for this service. The elastic limit of ordinary bolt steel is from 30,000 to 35,000 lb. per sq. in. It is possible in fastening nuts on such a bolt for a trackman to exert a strain exceeding this elastic limit with a 33-in. track wrench. When the parts of a frog or crossing spread somewhat under load and exerts additional strain on a bolt that has been stretched in tightening, it becomes loose and allows the whole structure to "work" and wear more rapidly. The special steel that is now being used has an elastic limit of 75,000 lb. per sq. in. and an ultimate strength of 100,000 lbs. per sq. in. Its elongation in two inches is 15 per cent and the reduction of area 40 per cent. The material can be bent double cold without a fracture.

A KEROSENE MOTOR CAR ENGINE

A new type of engine for motor car service designed to use kerosene as well as gasolene has recently been put on the market by Fairbanks-Morse & Co., Chicago, after more than a year's service on this company's section motor cars. No change has been made in the cars themselves, but a number of changes were necessary in the engine to permit the use of kerosene as fuel. As the new engine is built for the use of the more volatile oil, it runs equally well on gasolene.



No. 26. Kerosene Motor Car Being Used for Roadmaster's Inspection.

The fuels can be used indiscriminately, the change being made from one fuel to the other while the car is running by merely turning a valve. This arrangement is necessary, as the car must be started on gasolene to heat the cylinders before the kerosene is used.

A distinct economy in the cost of fuel is claimed for this new engine. Under favorable conditions cars in service are running from 25 to 28 miles on a gallon of kerosene at an average cost of fuel which does not exceed 1-3 cent per mile, as compared with at least 2-3 cent per mile with gasolene. These figures are based on 15-cent gasolene and 7-cent kerosene and it is assumed that the same amount of the two fuels is required. For average conditions outside of mountainous country it is said that 1 cent per mile for kerosene and lubricating oil is a fair estimate of the cost of operating the new engine. In addition to this saving, the use of kerosene is often more convenient, as large quantities are kept on hand for lanterns, headlights and other purposes. The use of kerosene also reduces fire risk to a minimum.

The kerosene engine is not materially different from any two-cycle gasolene engine, yet there are a few very important changes. The first is in the introduction of the fuel to the cylinder. The two-cycle engine of the carburetor type depends entirely on the volatile character of the gasolene. At each stroke gas is drawn into the crank case, compressed, and forced into the cylinder, where it ignites at the proper point in the cycle. Kerosene, on the other hand, when drawn into the crank case remains there, and does not reach the cylinder at all. In the Fairbanks-Morse engine a fuel-fed chamber is substituted for the carburetor, and air alone, instead of a mixture of air and fuel, is drawn into the crank case. On the down stroke of the piston this air is compressed and as the intake port is covered in the downward movement of the piston, it rushes through the by-pass into the cylinder.

There are two things to be noted in the design of the by-pass, which is the vital point of the kerosene engine; first, that it tapers, just before it joins the cylinder; and second, that its center line intersects and is perpendicular to the center line of the cylinder. The introduction of fuel into the cylinder depends on the former and the efficient operation of the engine on the latter.

The introduction of fuel depends directly on the fact that a gas rushing through a tapering passage does not exert an equal pressure on the walls of that passage at all points. As the passage tapers, the velocity of the gas becomes greater, and the pressure correspondingly less. The difference in pressure between two openings a short distance apart is enough to inject a spray of fuel with considerable force. The greater pressure is applied to the surface of the fuel in a full float chamber, while the lesser is exerted on a passage connected with the bottom of the chamber, but tilted upward enough to prevent any fuel from flowing into the by-pass from force of gravity. While the air in the by-pass is under compression the pressure is the same on both openings. There is no possibility of oil coming from the fuel chamber, except when air rushes through the tapered by-pass. The float chamber, solidly built in at the top of the horizontal cylinder contains merely a float, operating a cut-off valve. This valve opens and closes the passage to the fuel supply tank.

Supposing that the engine is on the up stroke, and the level of fuel in the float chamber is below normal, pressure in the crank-case, by-pass, and consequently in the air space of the float chamber, is below atmospheric. Fuel is drawn into the float chamber until pressure is equalized by the uncovering of the intake port. The partial vacuum created by the up stroke plays no part in bringing the kerosene into the by-pass or cylinder, but only in keeping the float chamber filled to the proper level.

On the down stroke again the air in the crank-case is compressed until the intake port of the cylinder is opened. There is then a rush of air through the tapered tube past the two openings that lead to the float chamber. A fine stream of kerosene is forced into the by-pass, striking perpendicularly the flow of air past the opening. The mixture of kerosene and air, going direct into the cylinder, strikes against the hot baffle plate of the piston, and is then in the best possible condition to be efficiently used. A two compartment fuel tank, with a larger section for kerosene, and a smaller one for the gasolene used in starting is provided. A two-way valve makes it possible to change instantly without slowing the car or losing an explosion, from one fuel to the other.

A decided advantage is gained in locating the fuel tank below the engine, instead of carrying it up under the seat. This arrangement prevents any flooding of the cylinder, even if there should be a leak at the float valve. It also greatly

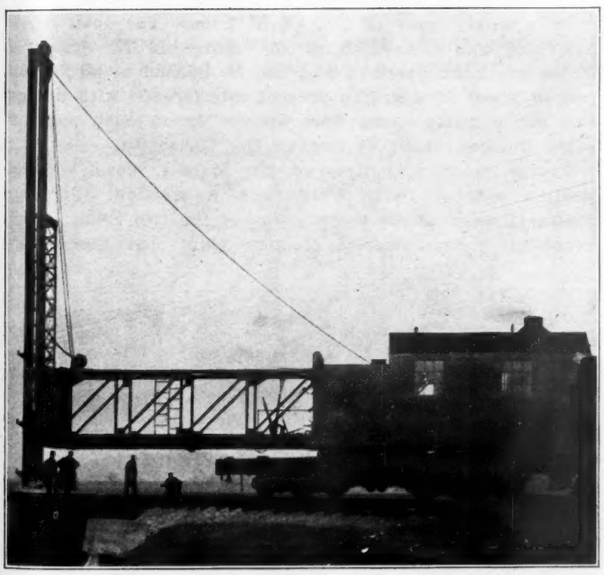
reduces the fire risk from a leaky tank damaged by accident. No oil from the tank can possibly drip on the engine.

The oiling system obviously had to be modified, as the former practice was to mix the lubricating oil for the crank and piston with gasolene. As no fuel enters the crank-case in the kerosene engine, this principle had to be abandoned. A sight feed lubricator has, therefore, been put on the cylinder, and the oil is regulated by the operator to the requirements of the engine.

In the trials that have been made on this engine it has been found to start easily, and to have a close speed control, accomplished by throttling the air intake. It has also been found that the engine develops more power than the carburetor type, and that it will keep running steadily after the cylinders become so hot that the ordinary type of gasolene car would not operate at all.

NEW PILE DRIVER

The McMyler Interstate Company, Bedford, Ohio, has recently built several pile drivers of a new type for the Missouri Pacific and the Cleveland, Cincinnati, Chicago & St. Louis. The machine is similar to this company's standard driver in being of the turntable type, but has a number of new features in its design. It has a reach of 20 ft. 3 in. from



Improved Design of Pile Driver.

the center of the forward axle at either end of the car to the center of the leads, and 33 ft. 9 in. from the center of the track to the center of the leads at right angles to the track.

The car body is built up of standard steel shapes with fish-belly girder side sills. The entire body is covered with steel plates riveted to the various members, adding to the rigidity of the frame. The truck has a capacity of 50 tons and the truck bolsters are fitted with nuts and jack screws which can be set up to release the weight from the springs and prevent tilting when the machine is driving piles. The turntable supports a double steel truss on which is carried the floor members, the swivel trunnions carrying the hammer leads, the engine, operating mechanism, boiler, water tank and coal bin. The central and rear portions are covered with steel plates.

A vertical boiler supplies steam to two sets of engines. The forward set operates the propelling mechanism, the sluing mechanism and the leader raising and lowering winch. The rear set operates the hammer and pile line. The operating levers are banked on the turntable forward of the center, where the operator has a clear view of the work.

The leaders are built up of standard steel shapes and are 42 ft. long. The hammer guides are 7 in. wide and 25½ in. between faces. The leaders are hung at the top of the truss and are further supported near the bottom of the truss by the swiveling attachment, which provides for an inclination of 1:4 for driving batter piles. This swivel attachment is operated by means of a hand wheel connecting with suitable gearing to a pinion in mesh with the circular rack. Either a drop hammer or a steam hammer may be used on this machine with equal facility. The driver weighs 140,000 lbs. in working order, not including the hammer.

THE LIFE OF STEEL TANKS

In the hope of getting some definite information as to the life of steel water tanks, the Chicago Bridge & Iron Works, Chicago, recently compiled what was intended to be a complete list of the iron and steel standpipes built in the United States previous to 1890 and wrote to the companies owning all of these tanks to ascertain the correct dates of their erection and the present condition of each structure. The following table shows the result of this investigation:

SERVICE OF STEEL TANKS

Year Built	No. of Tanks	No. in Service	No. taken Down	Date	Condition of Steel
Before 1860.....	4	2	1 1	1890 1910	Good Good
1860–1870.....	3	1	1 1	1904 1907	Good Good
1870–1880.....	19	13*	1 1 1 1 1 1	1904 1908 1909 1911 1912 1913	Good Good Good Good Good Good
1880–1890.....	21	21*	..	....	.....
Total.....	47	37	10	....	.....

*1 in bad condition.

The list included very few railway tanks, a large majority of the structures being built in connection with municipal water works. In practically every case in which these standpipes were taken down, the letters show that the old tank was abandoned on account of changes in operating conditions and in every case the condition of the plates was reported good. Most of the old standpipes are of small diameter and great height, which gives too great a variation in pressure to be satisfactory.

The first tank in the accompanying table to be built was erected in 1836 at Lancaster, Pa. It was 5 ft. in diameter and 75 ft. high. It was taken down in 1905 to be replaced by a tank of larger diameter, after a service of 69 years. The next tank built was at Louisville, Ky., in 1857. It was 4 ft. in diameter and 195 ft. high. It is still standing, although it has not been used for the last three years due to changes in operating conditions. It was in active service for 57 years. A tank built at Allentown, Pa., in 1860, which was 7 ft. in diameter and 76 ft. high, was taken down in 1910 after 50 years of service. The plates were in good condition at the end of that time the change being made on account of operating conditions. A tank built at the Ohio Penitentiary at

Columbus, O., in 1859, which is 10 ft. in diameter and 100 ft. high is still in service. The metal work has been painted at intervals of about three years and is still in good condition.

The list includes five railway tanks, one of which was built at the Forty-second street shops of the Chicago, Rock Island & Pacific, in Chicago, in 1867. This tank is made of 3/16-in metal and is still in service and apparently in good condition. Four tanks built for the Louisville & Nashville in 1870, which are 22 ft. in diameter and 8 ft. high with a capacity of 22,000 gals. each, are still in good condition and apparently will last for many more years. The Chicago Bridge & Iron Works reports that it has built approximately 3,000 steel tanks, all of which are in service to-day.

A MALLEABLE IRON BRIDGE TIE SPACER

The Borden bridge tie spacer has recently been put on the market by the B. J. Coghlin Company, Montreal, Que., and is now being used on the Canadian Pacific. This spacer consists of a malleable iron plate with heavy lugs extending down to keep the ties apart and a rib along the upper face of the plate to bear against the base of the rail. These spacers serve also as tie plates and are intended to replace both the wooden guard rails which are ordinarily lapped over the ends of the ties and the wooden spacer blocks which are placed between the ties. The renewal of single ties in the bridge deck is facilitated by the use of these spacers, as it is only necessary to loosen the spikes from four plates to withdraw any tie.

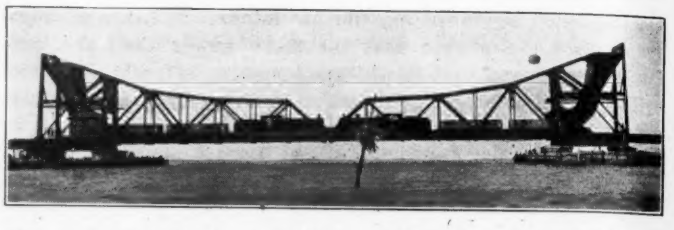
CONSTRUCTION OF THE INDO-CEYLON CONNECTION

The Indo-Ceylon connection is one of the most extensive recent railway engineering undertakings. This combined railway and ferry route connecting the mainland of India and the island of Ceylon has been completed this year, and was officially opened for traffic on February 24. The work consisted of extending the South Indian Railway from Mandapam, on the mainland of India, along a reef crossing the Palk straits from the mainland to the island of Rameswaran, the extension of the Ceylon Government Railway to Talaimanaar, on the island of Manaar, and the construction of piers at the railway termini for the use of ferry steamers connecting these points, which are about 20 miles apart.

The new route will provide an interesting railway trip for tourists between India and Ceylon, instead of the 200-mile sea voyage, which has been necessary. It will also be of importance in the transportation of Indian labor and cattle to the Ceylon tea and rubber estates, and in the general development of South India and Ceylon. The extension of the South Indian Railway will provide through service to the temple of Rameswaran and the bathing places on that island for the immense pilgrim traffic, which is one of the principal sources of revenue to the railway.

One of the most interesting parts of this work was the bridge construction across the Palk straits. This structure consists of 112 40-ft. plate girder spans, one 43-ft span, one Scherzer rolling lift bridge 289 ft. long, one 44-ft. plate girder span and 31 40-ft. girder spans. The piers supporting the girders are of granite masonry in cement mortar with concrete footings enclosed in steel caissons, which are founded on hard calcareous sandstone. The reefs on which this bridge is built consist of large blocks, partly above water, resting on softer sandstone on a stratum of compact sand. Although the reef is partly covered by water, in some places it is 6 ft. below low tide. The tidal variation is about 3 ft.

The rolling lift span crosses Pamban pass, an artificial channel made some 50 years ago, to provide for coastwise navigation. This is the only navigable channel between India and Ceylon and has a depth of about 14 ft. The substructure for the Scherzer bridge consists of two 9-ft. and one 12-ft. cylindrical concrete piers on each side of the channel. The cylinders are of ¾-in. steel, with bolted watertight joints, and extend down about 45 ft. below sea level into a stratum of stiff yellow clay. The cylinders on one side of the channel were sunk with air, and on the other with dredge and divers. To facilitate this work an artificial island about 60 ft. square, made of sandstone

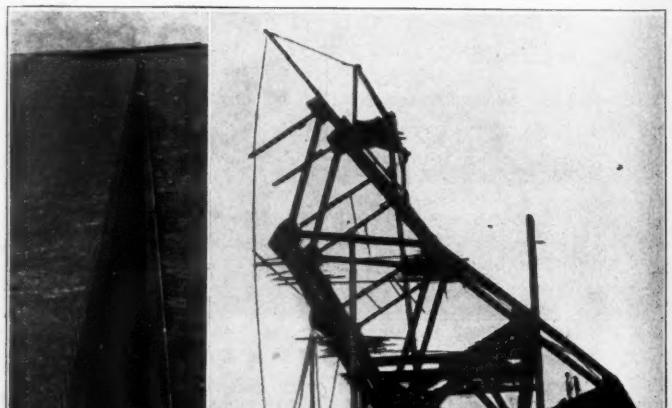


Scherzer Double Leaf Rolling Lift Bridge on Indo-Ceylon Connection.

boulders and concrete bags enclosed within a timber caisson and covered with clay and sand, was built on each side of the channel.

The bridge is a double-leaf through-rolling lift span, carrying a single track of 3-ft. 3⅜-in. gage. The span is 225 feet long and the width of the bridge 20 ft. The two leaves are hand operated and can be opened to an inclination of about 82 deg. To prevent interference with navigation the movable spans were erected in an open position, being inclined about 60 deg. to the horizontal.

Moplah laborers, natives of the Malabar coast, on the western side of India, were used in erection. Separate contracts were let for the erection of the two spans, which necessitated two sets of erection plant, but the rivalry



Palk Straits Viaduct.

Erecting Bascule Span with Native Labor.

created did much toward expediting the completion of the bridge. These laborers had little previous experience in bridge erection, but were strong and active and skillful in rigging work. The men were strict Mohammedans and therefore temperate. The average day's work was about 10 hours and was kept up seven days a week. A Mohammedan feast day occasionally interrupted the work, and during the fasting period, which continued for 30 days from

August 4, work was stopped at four o'clock every afternoon. During this time the laborers abstained strictly from eating, drinking, smoking and chewing from sunrise to sunset. The wages of these erectors were from 25 to 50 cents per day, and the coolie laborers received 8 to 16 cents per day.

The 400 tons of steel required for the Scherzer bridge was shipped from England, and arrived in July, 1913. It was transferred to scows and lighters of native boats, which were towed by a launch or poled by Indian boats, men to a material yard on an island near the bridge. It was transferred to the artificial islands at the bridge site as needed. Erection work was commenced on July 20. The material for each half of the two leaves had been painted a distinctive color, in addition to the erection mark, the colors used being brown and yellow for one leaf and gray and green for the other, so the most illiterate of the laborers could distinguish them.

Riveting, drilling and reaming were handled with pneumatic tools, for which a steam-driven compressor plant was installed on each island. Coal and water for the compressor engine and other supplies were brought to the island by boats. The riveting was a source of annoyance at first, due to the inexperience of the workmen, but with practice they were able to drive good rivets at a rate of 250 per day per squad.

When the fixed portion of the bridge had been erected and the segmental girders and some of the other pieces placed and blocked in position the counterweight boxes were assembled, and forms of ⅝-in. teak wood for the adjustment pockets were put in place by Indian carpenters. While these men used tools and methods not strictly in conformity with American and European ideas, they did very good work. Cribs of old railway ties were used to support the counterweight wings during the unbalanced condition of the leaves, and runways were built for placing the counterweight concrete. This concrete was mixed in a one-half-cubic-yard mixer, mounted on a pontoon scow moored alongside each island. The concrete materials were brought alongside in other scows. The concrete was dumped upon the deck of the scow and shoveled into galvanized iron dishes about 12 in. in diameter and 5 in. deep. These dishes were carried up the runway by coolies, who included young boys and women of all ages. About two cubic yards per hour were placed in this way.

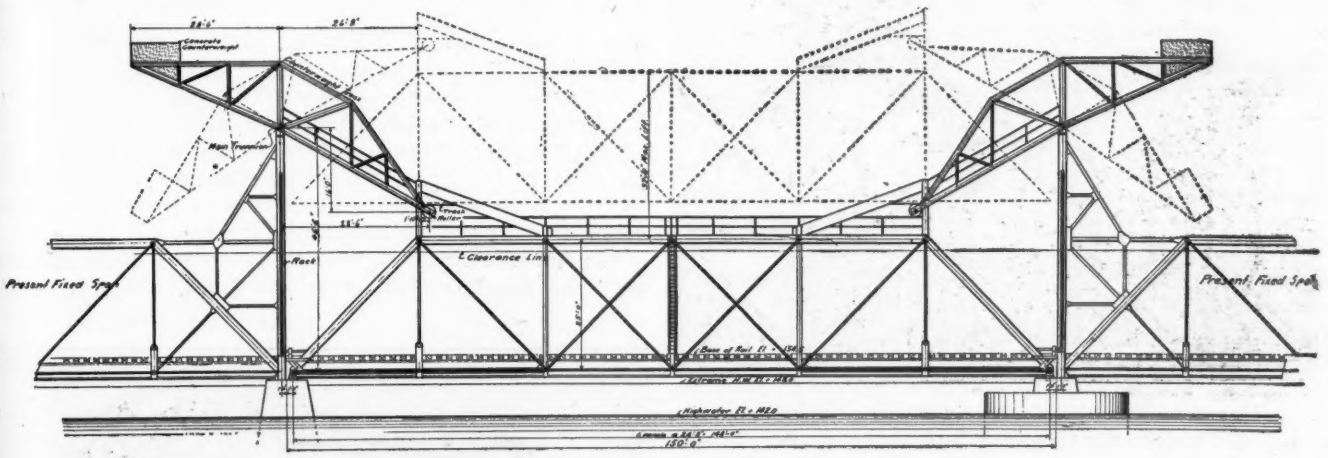
After placing two panel lengths of the top chord for each truss the adjacent web members and the machinery floor and bracing, an erection derrick was assembled on the top chord of the second panel to hoist the remaining members in sequence. The jibs of the derrick were 30 ft. long, so that erection could proceed one panel length ahead of the derrick position. Erection was interfered with to some extent by the strong wind, especially about the middle of October, when the southeast monsoon was concluding with a final blow.

The west leaf of the bridge was operated for the first time November 15, 1913, and the east leaf three days later. The test load on the bridge consisted of two locomotives weighing about 60 tons each, coupled head on, with two cars at each end loaded with coal, weighing about 34 tons each. The deflection measured under this test load amounted to about 0.19 feet, and for the train going at about 15 miles per hour the deflection was 0.20 feet. Regular passenger traffic was inaugurated across the bridge on January 1.

The lift bridge was designed by the Scherzer Rolling Lift Bridge Company, Chicago, and fabricated by Head, Wrightson & Company, of Thornaby on Tees and London, Eng. Robert White of London was the consulting engineer and H. T. O'Shaughnessey the executive engineer on the entire construction work for the South Indian Railway. R. L. Larson was resident engineer for the Scherzer Company.

ILLINOIS RIVER BRIDGE AT LA SALLE

The Chicago, Burlington & Quincy bridge over the Illinois river at La Salle, Ill., as originally built, consisted of five 150-ft. pin-connected truss spans. Recently the U. S. Government required that a movable span be provided with a clear headroom of at least 40 ft. above high water level when open. After careful consideration it was decided to convert one of the existing spans into a vertical lift bridge, allowing the Government requirements to be met at a comparatively low cost.



Elevation of Vertical Lift Bridge on C., B. & Q. at La Salle, Ill.

The "Rall" vertical lift type was selected, which is the first application of this new design. The maximum lift required to provide 40 ft. clear headroom is 32 ft. Stationary supports, substantially braced to the adjacent spans, are provided at both ends of the movable span directly over the piers. On these supports lifting girders are mounter, which pivot above the upper ends of the supports. They are counterweighted to balance the load of the lift span, so that the center of gravity of the total moving dead load coincides with the center of the trunnions on top of the tower posts. The forward ends of the lifting girders are connected to the lift span by movable connections consisting of rollers on the lifting girders, which move on tracks connected to the top chord of the lift span. This device provides also for expansion of both the lifting and the lifted spans.

The lift span when raised moves vertically. One end is

guided both longitudinally and laterally by the vertical tower posts, while the other end is guided only laterally, thus providing for expansion of the span. The roller end of each lifting girder describes an arc when the lift span is being raised, and the rollers of the lifting girders move forward on the track, reaching the extreme forward location for a mean position of the raised span, and move back to the original location, with reference to the track, for the completely raised position of the lift span. The maximum travel on the track is about 4 ft. each way.

For operating the lift span, racks are bolted to the vertical tower posts, which are engaged by pinions on a shaft mounted to the ends of the span. These pinions are driven from the center of the span by means of shafts and gears connecting to the motive power. In this case "hand power" is used at the present time, with provision for installing electric motors in the future should conditions of river traffic demand. The bridge is locked when in the closed position to prevent vertical or lateral movement.

The track girders are connected to the old span in such manner that no dismantling of the bridge was required and traffic was maintained at all times. The entire moving load in this structure is brought directly through the towers

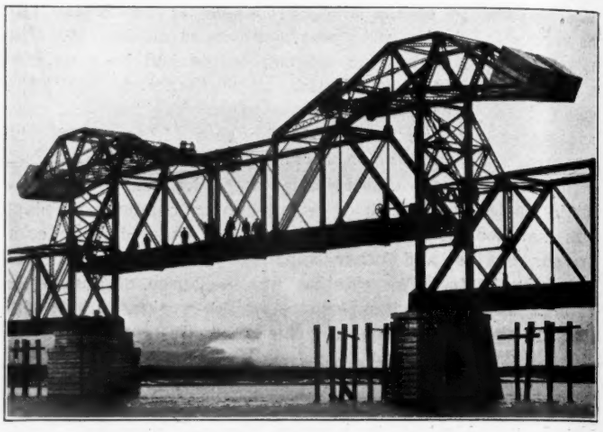
New Vertical Lift Bridge in Closed Position.

to the piers, without any portion going to the adjacent spans. This bridge requires no cables, sheaves or chains. The erection was started in September, 1913. The first work consisted of putting stiff chords in the end panels of the span and of chipping and drilling the old steel for new connections. Travelers were then erected at each end of the span, consisting of two "A" frames, one outside of each truss, capped across the top by two 12-in. by 12-in. timbers and thoroughly braced with 4-in. by 10-in. planking. The legs and base of the "A" frames were also 12-in. by 12-in. pieces. These travelers rested on 24 piles each, driven by a floating pile driver. Piles were capped by 12-in. by 12-in. timbers. The base of the "A" frame rested on the cap, which was long enough to permit the traveler being moved the distance necessary to erect the steel. The distance from the top of ties on the bridge to the under side of the cap was 68 ft.

All of the steel was hoisted by hand with two heavy crabs placed on the top of the truss span. The steel was stored at one end of the bridge and brought out on rubble cars, the heaviest piece weighing six tons.

The concrete counterweights contained about 45 cu. yds. of concrete each. The forms were suspended from the steel work. The concrete was mixed at one end of the bridge and hauled out in a ½-yd. bucket on a rubble car and hoisted by means of a cable running through a block suspended from the traveler. The power was supplied by a light single-drum engine, placed over one of the piers.

The machinery was then placed and the span lifted and lowered a short distance several times to get the counterweights adjusted. They proved to be too heavy, but a balance was secured by placing a few rails on the span. The span is lifted at present by hand power, and if it is found necessary to install other power the additional weight

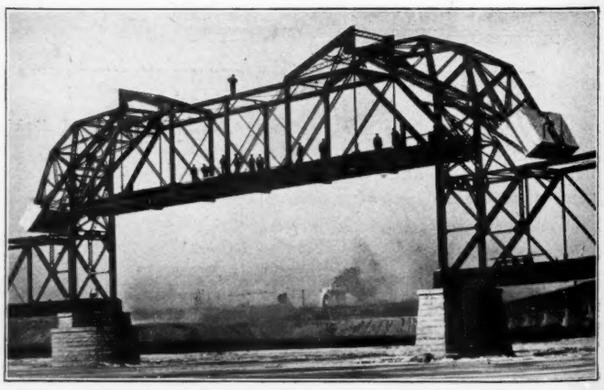


New Vertical Lift Bridge Partly Open.

will be taken care of by taking off the rails and adding concrete to the counterweights.

The travelers had to be wrecked hurriedly on account of a movement of the ice, which threatened to break off the supporting piles. This was done by sawing the caps of the travelers in two, one half falling upstream and the other half downstream. False work piles were pulled, so that no obstructions would be left in the channel.

The force during the erection averaged about 25 men until the counterweights were completed, and was cut to



New Vertical Lift Bridge Fully Open.

10 men when the machinery was placed. The riveting and some of the drilling was done by air furnished by a boiler and two Westinghouse air-brake pumps, placed at one end of the bridge. The span can be lifted to its full height of 32 ft. by four men on the slow-speed gears in about eight minutes. The design for this bridge was prepared by the Strobel Steel Construction Company, Chicago, and the work was done by company forces under the supervision of C. H. Cartlidge, bridge engineer and G. A. Haggander, assistant bridge engineer.